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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

AN ADDRESS DELIVERED AT THE UNITED STATES NAVAL WAR COLLEGE, NARRAGANSETT BAY, R. I., JUNE SECOND, NINETEEN HUNDRED AND THREE.

By Rear-Admiral S. B. Luce, U. S. Navy.

Mr. President and Gentlemen:—

It is a great compliment to have been asked to welcome to the College the class of officers who are to attend the course which opens today, and one I highly appreciate.

I perform this duty with pleasure and in behalf of the President and the faculty extend to you a hearty greeting.

As some members of the class are here for the first time, it will not be out of place to say something of the aims and objects of the College.

Although called a College, this institution differs from other seats of learning in having no teachers. A moment's consideration will show why this must be so. As its name implies the principal object of the College is the study of the Science and Art of War.

Now, war is a very large and comprehensive subject, and

there are no professors competent to teach it. It would be the height of presumption on the part of the College to undertake to teach officers of mature years—such as generally make up the classes in attendance—any branch, whatever, of their profession, even the most elementary. All that the College can do; all that it professes to do, is to invite officers to come to it; and to offer them every facility for pursuing the study of the highest branches of their profession. All here, faculty and class alike, occupy the same plane, without distinction of age, rank, or assumption of superior attainments. All are pursuing one and the same end—the advancement of their profession. In the beginning I, myself, if you will pardon a personal allusion, announced myself as one of the class in attendance, and each succeeding year I have, when practicable, enrolled myself with the class, and still find I have much to learn.

We speak, habitually, of the Science and Art of War. As a science it recognizes certain general principles which are just as applicable today as they were in the time of the great Athenian admiral, Themistocles. A strict adherence to those principles has not always insured victory, it is true; but a violation of them, either through ignorance or neglect, has almost invariably led to defeat. Military writers have been careful to warn us that although war, in its most extended sense, may be called a science, yet it is not an exact science.

As an art, war is governed by rules which vary from age to age. Art, it has been well said, may be *learned* but it cannot be *taught*. This is particularly true of the Art of War. It cannot be taught, excepting in so far as one may teach oneself; and it is to offer to every officer the opportunity of teaching himself that the College doors are open.

Naval Tactics, for example, is an art, proficiency in which requires constant practice at sea, under conditions assimilating, as nearly as possible, to those of actual war. The rules of this art are laid down in the Signal Book. Having mastered these rules, the student finds there is an extension of the subject, on which the Signal Book is silent, viz.: the formations for battle. Military writers have called the former Minor, or Elementary, Tactics, the latter Grand Tactics, or the Tactics of Battle.

A knowledge of the rules of minor tactics may be acquired in a comparatively short time. But grand tactics, or what may

be designated as the tactics of admirals, present such a variety of conditions as to defy all rules. The successful conduct of a fleet, in battle, must depend very largely today, as it ever has done, upon the genius of the commander-in-chief. An admiral may rely, for guidance in battle, upon the inspiration of the moment, only when that inspiration is due to long and conscientious self-culture in the line of his profession, not otherwise.

It is to enable officers to prepare themselves for the hour of conflict that the College has been opened.

Strategy is based on immutable principles—principles just as applicable today as when illustrated by the campaigns of the great captains of an ancient civilization. As to naval strategy, in particular, your attention is called to the fact that some of its most valuable work is that which is accomplished in time of peace. This subject also can be mastered only by close study and reflection.

To the foregoing subjects must be added the laws of war, as treated under the head of Marine International Law.

One of the first steps in the establishment of an institution somewhat novel in its character, was to furnish the facilities for carrying on these studies and to suggest certain lines that might be followed to advantage.

The foundation once laid, it was assumed that those who were to conduct the course, *conjointly* with those in attendance, would rear the superstructure. To this end a few officers came together each one of whom took up a particular branch of study. The results of those studies were given out in the form of lectures, and the freest discussion invited. Contributions by members of the class in attendance were cordially invited and gratefully received. Such is the case today. In short the College is, to borrow a term from political economy, a sort of cooperative or joint-stock affair, where all work in unison for the common good.

The next step in the process of development was to get at the philosophy of navies, to show the reason of their being, their influence on the destiny of the state, and their true functions in peace as well as in war. The necessity of a navy to a maritime state having been shown, then its relative proportions were to be determined, as well as its character due to the position held by the state in the great family of nations, and the

foreign policy sought to be carried out—whether the attitude of the state was to be purely defensive, or whether it was to be the offensive-defensive, that is to defend by assuming the offensive. If the latter then to show the necessity at all times for an advanced state of preparation. Thus was emphasized the fact that one of the most important factors of naval strategy belongs essentially to a time of profound peace.

These and kindred subjects are among the largest and most important that can engage the attention of the statesman and naval administrator.

That is the meaning of this College. It is a place of original research on all questions relating to war and to statesmanship connected with war, or the prevention of war.

That "war is the best school of war," is one of those dangerous and delusive sayings that contain just enough truth to secure currency: he who waits for war to learn his profession often acquired his knowledge at a frightful cost of human life.

We have often heard of the "Chess-board of European Politics." The game-board, now, is the great globe itself; and America, by her very geographical position, between two great oceans, is not the least important of the several contestants.

It is related that a gentleman living in one of the Eastern States, once remarked that the flow of the Mississippi was towards the north. His father's plantation, he said, was on the left bank of the river, and often, as a boy, he had noticed how the driftwood floated away to the right, which was to the north. No argument could convince him to the contrary. He had that evidence of his own senses and that was enough. Business matters required that he should revisit the home of his childhood. He sought the old steamboat landing, and there, just as he remembered it, the waters were carrying the driftwood to the north. He was right; right, that is, from the point of view of childhood. Watching still the driftwood he saw it whirled about in an eddy. Looking farther out he saw it carried by a counter-current beyond the bend of the shore where he stood, and into the great body of the mighty river which swept its resistless way to the gulf. This is not an inapt illustration of the so-called anti-imperialist who looks at the little eddies and counter-currents at his feet, and is blind to the great stream of human progress which has been

setting in one undeviating way since the world began. "Westward the course of empire takes its way," can never become, to us, a hackneyed phrase. Its truth is receiving fresh proofs every day. From the day of the battle of Salamis, when a small, but highly disciplined Greek fleet beat back the tidal-wave of barbaric invasion, to the day our flag was planted on the Great Wall of China is a far cry indeed. But the laws of motion are immutable, in the one case as in the other—in the flow of the great river, and the ever onward current of human events. The Mississippi can not give back its waters to their source; nor will the Star of Empire turn to the East.

Civilization is ever saying to the barbarian, and to the semi-civilized, "accept the bountiful gifts of nature, or make way for those who will." Thus there is a continual struggle for supremacy before which barbarism is constantly retreating. The stream of human progress is still sweeping on; and woe betide those who oppose its course. This means much for us, here, today.

Glance for a moment at the past and then contemplate the possibilities of the future. The invention of the Mariner's Compass, the discovery of America, and the Reformation are three events which mark distinct eras in the world's history—grouped together, in their order of time, they illustrate in a remarkable manner the unity of purpose in working out the destiny of man.

The Mariner's Compass enabled the navigator to seek for the lost Atlantis amid the mysteries of an unknown sea; and led Columbus to a continent of vast proportions. Then came the Reformation when men fled from their homes across the waste of waters for opinion's sake. In the virgin soil of the new world new forms of political life germinated and bore fruit. Colonization followed. Oppression drove the colonies to rebellion and new states sprung into existence. These United States were still sparsely settled when the tempting bait of gold, in California, drew the tide of emigration across the mountains and peopled the Pacific slope. Then came the war with Spain, and Hawaii, Guam and the Philippines, those stepping stones across the Pacific, followed.

The world is growing impatient for an isthmian canal and will brook no frivolous excuses for delay. Strategic points in the Caribbean, and in the Pacific, must be held and strengthened;

and coaling stations and repair shops, under ample protection, must be provided.

The Monroe Doctrine alone demands a careful consideration of these questions.

Our Mercantile Marine.—An intelligent study of naval policy must necessarily include our shipping interests. The military marine and the mercantile marine are interdependent. The navy, while policing the sea, protects our foreign commerce, and in time of war, finds there its greatest reserves. It was once observed that we had "clipped the wings" of commerce and driven our carrying trade to foreign bottoms. The same is practically true today. Thus we are not only contributing indirectly to the support of foreign navies, which may some day be opposed to our own; but we are depriving ourselves of what would prove, in time of war, an auxiliary of incalculable value.

The remedy for this deplorable state of affairs must, necessarily be left to the wisdom of Congress. But the navy, with no other interest in the question save that dictated by the highest sense of patriotism, discharges an imperative duty, in urging as a military necessity, the re-habilitation of our mercantile marine.

These and kindred subjects belong to the strategy of peace, each topic finding its place in the College course.

The imprisonment of American Missionaries, and the massacre of Christians, by those under Turkish rule, are a constant source of irritation to the people of this country; and may some day strain our foreign relations to the point of rupture. On the other hand the preservation, in China, of what has come to be known as the "Open Door," a policy essential to our commercial interests, requires unremitting attention. With the map of the world constantly before us we must needs be ever at the switch-board to keep in touch with whatever may be affecting our interests, hour by hour, in one quarter of the world or another.

Change, continual, unremitting change is the law of the universe. The solid earth itself is in a constant state of flux. Stagnation means atrophy and death. It is not enough for us to keep abreast of the times. This College must be in the very front rank of the advance guard of progress. To obtain some perception, however dim, of the future, we must study the past.

This teaches us that the civilization we now enjoy was brought about by war. The proud position we, as a nation, now occupy, was rendered possible only by wars, and future problems in the destiny of man will be worked out through the instrumentality of the sword. There is no escaping it. Tears and tirades are here of no avail.

We are no apologists of war. Heaven forbid! We simply regard it, from a common-sense point of view, as one of the many evils flesh is heir to. War is a dreadful scourge we all admit. It is a relic of barbarism. We admit everything that can be said against war. But after all has been said, no student of history, however superficial, can deny that through that same dreadful scourge, ultimate good has been brought about. It has been so in the past, and, as far as human discernment can go, it must be so in the future.

War is not the only scourge man is heir to. Droughts, and resulting famines, by which thousands of innocent people have perished, as in India, through the slow torture of starvation, have proved more cruel than wars, and without their compensations.

The recent war with Spain cost but few lives, and comparatively little suffering, while Mt. Pelée, on the Island of Martinique, swept out of existence an entire community of peaceful people. The war relieved Spain of colonies that had become burdensome, and in a manner that saved her honor. It was a war in the interest of civilization and human progress. But what end is served by pestilence and famine, and those convulsions of nature by which whole populations are swallowed up? The answer is locked up in the mysteries of an inscrutable Providence. All the Christian can reverently say is: "Thy will be done."

As between the various scourges inherited by man there is one marked difference. No human foresight can provide against earthquakes or volcanic eruptions or pestilence or famine. War, on the other hand, may in certain instances, be averted. But mark this well: It may be averted in one way only and that way is to be fully prepared for it. That is the meaning of this College: it is an instrumentality for the prevention of war by being prepared for it.

It is right here where the College joins hands with the Uni-

versal Peace Societies. To be prepared for war is the rôle of that naval strategy, which belongs to a period of peace. To be in the right place at the right time, and with adequate force, means success by checkmating your adversary in the first few moves. Campaigns have been won without firing a shot simply by skillful strategic movements. War has been defined as a question of positions and the most brilliant campaigns have been worked out on the map. It is the business of this College to study all the various problems of war as they may affect this country. The possibilities, indeed the probabilities, of future wars, and our duties in amply preparing for them, have been dwelt upon for the reason that contrary doctrines have been publicly proclaimed.

Every right-minded person must unite with the Church in praying to be delivered "from battle and murder and from sudden death." We all sincerely hope that arbitration may ultimately prove the sovereign panacea for the great curse of war; and that the doors of the temple of Janus may be forever closed. But Janus, though represented as a god, is also represented as "two-faced," and not always to be trusted; and arbitration fails, unhappily, when most sorely needed.

Do we not recall how it was said of old that the Lord sent a lying spirit to Ahab, King of Isreal, that he might go up and fall at Ramoth Gilead? And how the god of the Greeks sent a spirit in the form of a "deluding dream" to Agamemnon on the plains of Troy?

"And thus the flattering Dream deceives the King!"

Beware of false prophets! The race is not extinct.

It is quite unnecessary to explain to such an audience as I have the honor of addressing, that the College, itself, has no power, whatever, to act; nor authority to formulate a naval policy. Its aim, as stated in the beginning, is simply to invite officers to meet together to discuss questions pertaining to the higher branches of their profession, and enable each one, according to his own inclinations, to prepare himself for the highest and most responsible duties that can devolve upon a naval officer.

One thing must be borne in mind. At the firing of the first gun proclaiming war, the so-called "inspiration of genius" may be trusted only when it is the result of long and careful study and reflection.

Art is a jealous mistress; most of all so is the art of war.

If attendence here will serve, in any degree, to broaden an officer's views; extend his mental horizon on national and international questions, and give him a just appreciation of the great variety and extent of the requirements of his profession, the College will not have existed in vain.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

TORPEDO TUBES IN BATTLESHIPS.

By COMMANDER J. B. MURDOCK, U. S. Navy.

It is somewhat remarkable that no discussion has arisen in the Naval Institute concerning the abolition of torpedo tubes in the new battleships, as there is no question as to the opinions held by most officers on the subject. There is apparently an idea that the tubes will be restored, but if the abolition is calmly acquiesced in by the professional opinion of the service, such action is liable to be construed as approval, and the ships may reach a stage of construction in which it will be difficult to put the tubes in place.

In the absence of any assigned reason for abolishing battleship torpedo tubes, there is nothing to be argued against, and it is difficult to imagine the considerations which recommend such action. A naval constructor is of course confronted with grave questions as to structural weakness, and may be led to question very seriously the alleged advantages of submerged tubes, before deciding that the structural problem must be faced and overcome. The line officer, however, while appreciating the necessity of extra strength of hull if submerged tubes are used, is confident that the skill of the constructor can provide such strength, as has been done in all prominent foreign navies, and is naturally led to a consideration of the tactical importance of the tubes, as a reason for their retention.

The battleship must come into the hands of the tactician as a perfected instrument. Once constructed, there is but little probability of any extensive alterations being made, those which experience may have shown to be necessary being adopted in new construction only. Although often discussed and recommended, we have as yet taken no steps towards rectifying the serious faults

of the Oregon class, and in all likelihood never will. The only sure way to have things right in battleship construction is to make them so at the beginning. A battleship may be considered as having a definite amount of potential efficiency built into her, and the best officers and crew in the service can at no time during her career get more fighting efficiency out of the ship than the constructor has put into her when building. In considering the maximum potential efficiency of a new type, we must always bear in mind that the service efficiency will be much less, as the human element must then be considered, and humanity is always fallible.

This principle is well understood and we have, as a rule, in all our naval construction, provided a high potential efficiency. Sacrificing guns and armor to speed has occasionally been indulged in, but we are now working apparently on safer lines, and have given up the straining for the "last knot," the attainment of which turns a fighting ship into a comparatively harmless ocean greyhound.

Our latest constructions provide ample gun power with good protection, but we have never given as much weight to torpedoes as other nations have done, and have largely ignored the possible results of their use against us. In short, we are building battleships with neither torpedo tubes nor nets, apparently laying down the law that battleships need not use torpedoes, and have nothing to fear from those of an enemy. Who is right in this contention, we, or the rest of the world?

At the very best, we are basing our construction on pure assumption. No battleship has ever been sunk in action by a torpedo, but the main reason may be that no general battleship action has taken place under modern conditions. The same reasoning applies equally well to the gun, as no battleship has been sunk by gun-fire, and yet there is no question in our minds as to the utility of the gun. We believe in it thoroughly, and are doing our best to develop its service efficiency, but should it be our only offensive weapon?

It is eminently unsafe to theorize as to how the battles of the future are to be fought. In the discussion preceding the adoption of the type of the Georgia class, some officers advanced as a reason for placing broadside guns in a citadel, and doing away with end-on fire, that as all battles would be fought broadside on, fore and aft fire was useless. We laugh at the Chinese who build their guns into the masonry of their forts and wait for the enemy

to move into line of fire, but copy their methods when we give any weight to such arguments as the above. A ship fitted for broadside fire only has low potential efficiency, and her officers and crew are ever afterwards handicapped in their attempts to develop her fighting power.

It is very unsafe to give a commander-in-chief any specific instructions as to how he shall handle his ships in battle. This must be left to his discretion, and the tactics he will adopt depend mainly on three considerations: first, what he wishes to do; second, what his ships are capable of doing; and third, what his adversary does. Fixed rules and definite prescribed action are evidently out of the question, but if ships of limited potential efficiency are furnished him, he is handicapped by the fact that he cannot carry out ideas which call for good instruments. If, on the contrary, his ships are good ones, designed for all around work, the admiral has a much freer hand, and the tactics of battle may reach a higher level.

For the two remaining considerations no rules can be given. The first one, what the commander-in-chief may wish to do, is practically insoluble, even if we know the admiral's temperament and professional character. It is safe to believe that the responsibilities of command, and the consideration of the serious results that might befall the country if its main battle fleet were destroyed, will temper the ardent zeal of even the most confirmed fire-eater, and that he will enter battle with caution, commencing with gun-fire at long range. Beyond that nothing can be predicted. If he finds he can destroy or put his enemy out of action at long or moderate range by gun fire alone, he will probably try to do so, and avoid coming to close quarters. The same general rule applies to the enemy, and a gun fire action may therefore be anticipated as the first stage. In this, however, one side will probably be worsted, and begin to see that its guns will never win the victory at moderate range. It must either accept defeat, more or less decisive; endeavor to withdraw; or force the fighting at closer quarters, where it can use ram and torpedo in addition to its discredited guns. Chance must largely rule in a melee, but chance may avert the impending defeat.

Close action may, moreover, be deliberately sought by the victor to crush an already defeated enemy, and make his victory overwhelmingly decisive. It may also be forced by an ardent admiral,

if the preliminary gun-fire action is indecisive. It may occur through accident when not sought by either combatant. Signals not seen, or read wrong; or accidents to the signal apparatus which prevent certain signals being made, may result in fleets coming together in spite of the endeavors of both admirals to keep apart. And last of all, your opponents tactical opinions, or lack of them, may lead him to force close action at the very outset.

Rough as this analysis is, it is apparently enough to show that close action will probably occur at some stage of the future naval battle, and even if the probability should be changed to a possibility only, it must be given weight, and our ships built so as to be fitted for fighting under such conditions. In closing in on an enemy, a fleet first encounters his zone of torpedo fire, which now begins at 2000 yards, and if it still advances the ram also becomes a weapon. If now the attacking, or "A," fleet is without torpedoes, it is handicapped at all ranges inside of a mile. If it does not suffer it is due to the enemy's inefficiency only, and the danger due to his possessing an extra weapon becomes the greater as the range is diminished. A fleet of battleships at distance presents a fine torpedo target, and even if the defending, or "D," fleet lacked skill, he would have but poor luck if none of the numerous torpedoes he fired took effect. The "A" fleet in the meantime must push on, depending on gun-fire alone, until near enough to ram. There is so much uncertainty connected with the use of the ram in fleet actions, that it is doubtful if either fleet would deliberately seek to ram except as a last desperate attempt to gain the victory when defeated at the guns, and if the fleet choosing to ram is also without torpedoes, and is already beaten at the guns, it is courting absolute destruction.

Considering the case in which the attacking fleet has torpedoes, and knows that its opponent has none, "A" possesses the distinct tactical advantage due to extra weapons. It can look forward to close action with a greater probability of success, and if its gun-fire is anywhere near as good as that of the "D" fleet, may seek action inside of 2000 yards, where it can re-enforce its gun-fire by its torpedoes, without running any risk of receiving greater proportional damage than before, while its possibility of inflicting fatal blows is vastly increased. If the gun-fire of the "D" fleet is greatly superior, as it is in our new ships, it still affords no immunity against torpedoes, unless sufficiently powerful to wholly

disable or sink the attacking ships before they reach the limits of good torpedo range, and this is extremely improbable.

The omission of torpedo tubes in our battleships seems therefore to be a mistake, in that it gives an enemy carrying torpedoes an advantage over them at all ranges inside of two thousand yards. This advantage is real, in that it gives him a possibility of speedily destroying our ships without running any greatly increased risk himself; it is tactical in that he can manouvre in closer order than he would dare assume if threatened by our torpedoes; and is moral in the discouraging influence that would be exerted on our personnel when it was found that the enemy had reached torpedo range in spite of all our efforts to prevent it by gun-fire. Another moral effect of torpedo tubes is that if a fleet is fitted with them, its opponent is less liable to seek close quarters.

It is the announced intention of Congress to have our new battleships of the most formidable type, and the Department has taken the greatest care to carry out this wish. The fact that decisive action on the question of submerged torpedo tubes has apparently been postponed until the last moment leads to the hope that they will be put in place, and that the finished ships will not be inferior to those of other navies in the all important item of torpedo armament, but can meet their enemies on at least equal terms in all the varying circumstances of modern battles.

DISCUSSION.

Captain CASPAR F. GOODRICH, U. S. Navy.—I have always been a strong advocate of the special tool for special work. In the class of special tools, the torpedo assuredly took its place, so long as its range was restricted to a thousand yards and less, a distance to which we have every reason to believe battleships can not approach each other with hostile intent, without receiving such damage from gun-fire as to put one, at least, out of action. Indeed this limit may, very properly, be extended to nearly two thousand yards through the influence of the vastly increased power of the guns. If then, the gun is to decide the issue before battleships get within reach of the torpedo, why should they carry a weapon which is purely special and relatively local in its zone of destruction.

Upon such considerations as the above have I based my satisfaction in the omission of torpedoes from some of our battleships. That the torpedo *might* be useful, no one could deny, but that the probabilities of their usefulness were so great as to justify the expense, weight,

bother, sacrifice of space, etc., of under-water tubes appeared to me exceedingly unlikely. Moreover, in common with many others, I feared our numbers in fighting ships would continue so small as to make the single ship action the rule of any war in which we might become involved and the fleet action the rare exception. All this has now changed, and we no longer make the ship the unit but we speak and plan in terms of squadrons and fleets. What was wise ten years ago may be foolish to-day. Are we, in short, warranted in deliberately discarding a weapon which, in spite of its long history of many failures and few successes, engages the serious consideration and wins the acceptance of foreign naval officers, without knowing exactly what effect our decision, made now, will have on the sea battle of the future, or in adhering to an opinion which however true when eight hundred yards was the maximum scope of the torpedo is not necessarily true to-day when that scope has been extended to two thousand yards?

Commander Murdock never makes a contribution to professional literature which does not command respectful attention. It may please him to learn that this paper has secured one proselyte, at least, and that, owing to his analysis of the approach, of the main action and especially of the mêlée I am forced with reluctance, be it confessed, but with as much grace as is possible, to join with him in thinking it prudent to install the under-water torpedo in our present and future constructions.

Rear-Admiral R. B. Bradford, U. S. Navy.—1. I fully concur in the statements made by Commander J. B. Murdock, U. S. Navy, in his paper entitled "Torpedo Tubes in Battleships."

2. The plans for the Virginia class of battleships included the installation of torpedo tubes but they were removed after the ships had been contracted for upon the recommendation of 4 members of the Board on Construction. For the same reason they were omitted from the Connecticut class of battleships. It is not proposed by the Board to include any facilities for using locomotive torpedoes in the Idaho class of battleships.

3. I have persistently opposed this policy but being a minority of one have naturally been overruled in the matter by the Department.

Captain R. R. Ingersoll, U. S. Navy.—I fully concur with Commander Murdock that submerged torpedo tubes are a necessity for battleships, in view of the development of the torpedo in accuracy and range, that they should be installed in battleships not now provided with them, and form a feature of all new designs even at the expense of the reduction of the number of guns in the intermediate battery.

Captain C. S. Sperry, U. S. N.—I fully concur with Captain R. R. Ingersoll.

Captain C. H. Stockton, U. S. Navy.—The experience I have had in command of a battleship, in association with battleships of other naval powers and in contemplating the possibilities of fleet action compels me

to place a word of agreement on record with the advocacy for the retention of submerged tubes for torpedoes on battleships. We seem to be the only naval power playing into the hands of a possible enemy by the abolition of torpedo apparatus on board of battleships. Other countries are perfecting the use of torpedoes, by increasing their range, speed and accuracy in connection with battleships while the pendulum of naval official opinion on our part has gone (a not unusual thing) to the other extreme in this matter.

With a torpedo making the speed of 37 knots at 1000 metres and 25 knots at 2000 metres about to enter the field the question of our handicapping by this abolition does indeed need reconsideration. What will our ordnance do at the enforced increase of range?

Commander F. J. DRAKE, U. S. Navy.—The question of "Torpedo Tubes in Battleships," is very ably discussed in the original paper presented by Commander Murdock.

A careful consideration of this subject places it at once in the category of theoretical topics without any practical demonstrations of its efficiency in battle.

All arguments then, pro and con, become factors of personal opinions of an untried quantity under battle conditions.

The battleship is designed to develop the highest degree of fighting efficiency as appertaining to its invulnerability, and capacity to deliver the largest number of shots per minute representing a maximum energy in destructive force.

The question of speed appertains to tactical efficiency, which is not a destructive force that can be measured and calculated with accuracy, as in the case of gun energy, and hence does not enter into the mechanical efficiency of battery power; it is purely a potential efficiency.

I do not agree with the author that the battleship may be considered as having a definite amount of potential efficiency built into her, as the latter, unlike the battery, is a probability, and not a fact, and therefore does not represent so many known units of energy in destructive force, as exists in gun efficiency.

I consider potential efficiency as depending upon the nerve and tactical skill of the commanding officer in action, the degree of perfection reached in the organization, and capacity of the crew to serve the battery and fight the guns.

The destructive force of modern high-powered guns has been determined and demonstrated frequently, not only on proving grounds but in battle.

The potential efficiency of submerged torpedo tubes is a factor of possibilities, and has never reached the stage of practical results in battle, or mock battle in fleet manœuvres between battleships.

Above-water torpedoes like the Oregon class are not to be considered.

An attempt to use the Oregon's torpedoes in battle, would simply mean one's own destruction by opening the vitals of the ship to the enemy's fire, or going to sea with lower air ports open for the sport of

wind and wave, as has been experienced with the Oregon in a moderate seaway.

A valuable degree of potential efficiency has been developed in the crews of our battleships, both in battle and target practice, in the effort to raise the standard of gun-fire so that the gun will deliver a maximum striking energy in a given space of time.

The effective force of gun-fire can be seen by the gun's crew and errors corrected.

Modern mechanism in mounts and proficiency in gun drill enables a gun's crew to correct errors of aim in battle; whereas such is not the case with the unknown quantity which represents efficiency in submerged torpedo discharge.

The gun-pointer in a battleship is able to bring the gun sights and the object fired at in line when within the arc of train and visibility, thereby eliminating possible errors of more than one person.

Not so with the under-water discharge of a torpedo; as it must be launched by the action of the director, or more than one person, thereby involving errors of greater magnitude than the gun.

Where is the efficiency in the torpedo director in the conning tower, or in any other place, which involves the will or attention of the commanding officer in the heat of battle?

He has all he can do to attend to the careful conning of his ship, moving even at a fighting speed of ten knots, and cannot afford to lose sight for one moment of the juxtaposition of two vessels approaching the torpedo zone of fire.

The moral effect arising from the small percentage of chances in favor of a torpedo reaching its mark in a running fight between battleships, carries with it a degree of certainty which probably the majority of commanders would consider, if forced to fight inside of 2000 yards.

As regards nets, the old time argument; battleships in my opinion have no use for nets.

If compelled to anchor on hostile grounds, torpedo chasers or destroyers of 2000 tons displacement, having a large cruising radius of efficiency and high speed, will be sufficient watch-dogs to keep the enemy's torpedo-boats at a safe distance.

The torpedo net has never been found in practice to be of any use underway, and is a menace to tactical efficiency, as well as a friend to the enemy.

The utility of the gun has been demonstrated, whereas the same cannot be said of the torpedo.

No fixed rules can be laid down for tactical conditions in battle.

If torpedoes are to be considered as the bulwark defining battleship tactics, then all battles of the future must be fought outside of the zone of torpedo fire.

With the modern high-powered gun, smokeless powder and armor-piercing shells, the naval battles of the future will without doubt commence at longer range, or technically speaking, middle range of 6000 yards, and the day is not so far hence when target practice will have to be considered at this distance.

From the standpoint of the fighting efficiency of gun versus torpedo in battleships, as a known quantity, I am not in favor of lumbering up a battleship with torpedoes.

On the other hand I agree with the author of this very important paper, "that close action will probably occur at some stage of the future naval battle."

That is inside of the 2000 yard range.

The percentage of chances in favor of "D" fleet in firing torpedoes, or making such fine calculations for their own speed, as well as that of "A" fleet, that the individual torpedoes of "D" shall be effective after discharge, in reaching "A" respectively, is so small, that such handicap may not be considered.

The ratio of "A's" chance of being handicapped is practically illustrated in the following hypothesis, covering outside limits.

"D's" torpedoes have a speed of 30 knots maximum, "A's" battleships a speed of 10 knots minimum; torpedo range 2000 yards.

"D" fires when "A" enters torpedo zone, basing his calculations on "A's" speed, which he has determined to be ten knots.

"A," being a fairly good tactician, increases his speed upon entering the torpedo zone to 15 knots, so that "D's" calculations for space passed over by "A" instead of being about 660 yards, will be about 990 yards, a difference of 330 yards in favor of "A" not being hit.

In the meantime "A's" powerful battery at pointblank range if served at all with any degree of efficiency must win the battle, as it takes time for "D" to launch another torpedo where accuracy depends upon the speed—space given to "A" by "D."

With increased efficiency in gun-fire, and higher velocities in the 45 and 50 calibers, in all probabilities, the greatest damage will be done between 8000 and 3000 yards, in future battles, and the probability of short range inside of the torpedo zone will be limited to unavoidable errors in tactical manœuvres of one or the other combatant.

Superior gun efficiency on one side need not fear torpedo attack on the other, unless the latter sees himself beaten at the guns, and with his greater speed resorts to the last hope and closes in, trusting that a well-directed torpedo may reach its mark and give him that one chance of escape.

Therefore the omission of torpedoes in our battleships, in spite of their inefficiency as compared with gun-fire, carries with it a moral advantage to an enemy who is equipped with submerged tubes, such that he may make the desperate effort to reach the torpedo zone of fire, if outclassed in gun-fire and possessing the greater speed.

On the other hand, if our battleships maintain the highest speed efficiency with the greatest gun-fire efficiency, then the omission of torpedo tubes becomes a minimum factor in considering the moral advantage gained by an enemy possessing submerged tubes.

Their absolute omission, however, may become a menace to our future safety from attack by a nation having submerged tubes in its battleships, and who feels that our rapidly expanding commercial interests abroad are encroaching upon its avenues of trade.

Commander E. B. BARRY.—I think Commander Murdock's article on under-water torpedo tubes in battleships a very timely one.

Naval officers are divided into three classes: First, they that accept everything just as it comes; secondly, they that controvert everything; thirdly, they that accept one thing and object to the next, so to speak in rotation.

Class I says, that thing is A's business, therefore, it must be done by him or else it cannot be attempted, still less accomplished by any one else. On the other hand class II wants a finger in the negative pie whatever may be the question raised. Yet here we are confronted with a question that seems to be vital, far-reaching and of the utmost importance, that has been utterly ignored by the service until Lieutenant-Commander Poundstone raised a note of warning in his admirable essay on type battleships; to be closely followed by the present article.

I hope sincerely I do not belong altogether to class I, but I fear nearly the whole navy got into it on the question of under-water torpedo tubes.

To me the question apparently does not admit of argument. Experiments carefully conducted and extending over years have shown neither weakness nor failure in under-water tube installations, why then are not they installed?

Is it because *above-water* tubes are considered more dangerous to the vessel carrying them than to a possible adversary? Is it because the extra weight required cannot be allowed without taking away a few pounds of coal or some small storeroom?

In a vessel of 16,000 tons displacement, 50 tons will cover the under-water tube fittings and this weight would not be missed from the other elements.

The question of comparison apparently admits of but one answer. Is a battleship fitted with under-water torpedo tubes and carrying a full topedo outfit, any more powerful or any better fitted for offense and defense than is another battleship of equal size, speed, protection and battery, but carrying no torpedoes?

I hold that the single ship loses less from want of torpedoes than does a fleet. One of the peculiar conditions where the parts taken separately seem greater than the whole. But it must not be forgotten that ships in fleet formation cease to exercise that individual freedom of movement that characterizes them when by themselves—hence the attack of torpedoes upon a fleet, apart from the size of the target, is more likely to succeed as the torpedoes are less easily avoided.

Single ship actions also are more likely to bring on the use of torpedoes only towards the close of the battle.

With what confidence will not a properly equipped fleet secure against torpedo attack, approach to torpedo range, maintaining a presumably equal great gun-fire. It would be sad indeed if one or more of the opposing vessels in their fleet formation were not torpedoed. With its increased speed and with the Obry directing attachment the torpedo is becoming, if it is not already, an arm of precision.

Why should we discard, or rather omit it?

No one can believe that torpedo boats and destroyers are going to protect a fleet in action against torpedoes. Whether conditions may neutralize a flotilla when it is most needed, while an equal or superior force of enemy's torpedo vessels would keep it too busily employed to undertake the agressive rôle of battleship protectors.

Commander Murdock's supposititious fleets carry on the action at long range, I cannot agree with him in the case in point. With anything like equality of force the admiral of the "torpedo fleet" will have every reason to reach torpedo range as quickly as possible, and if his vessels are possessed of end-on fire, which is presumed to be the case, he can reach a proper range for his torpedoes without having suffered greatly from gun-fire, or else he will force his adversary to retreat. Will the tempered zeal of even the most confirmed fireeater care to retreat? If he does retreat he must be faster than the torpedo fleet or else he is put to stern fire against bow fire—usually somewhat inferior—and a final torpedo range for his pursuer. He will have rather a bad quarter of an hour making up his mind to risk almost certain destruction attacking a fleet equipped with torpedoes when he has none. I doubt if one vessel could live to use the ram; what the gun failed to do would be done by the torpedo.

I can see readily enough why it is not necessary for unarmored vessels, except torpedo boats and destroyers to carry torpedos, but I fail utterly to grasp the conclusions and logic that keep them out of battleships and armored cruisers.

I join with Lieutenant-Commander Poundstone and Commander Murdock in the hope that alterations in vessels building are not yet too late, and that our newest types of battleships will be what congress expects, "battleships of the most formidable type"; this they never will be without under-water torpedo tubes.

Commander BRADLEY A. FISKE, U. S. Navy.—I agree with Commander Murdock, both in the conclusions which he draws and the reasons which he gives.

The weight saved by leaving out the torpedo installations from these ships cannot possibly be put into anything else which will compensate the fleet for the tactical handicap imposed. The torpedo has no substitute.

Lieutenant-Commander W. L. RODGERS, U. S. Navy.—Commander Murdock's paper in regard to torpedoes on battleships covers the ground so thoroughly that one can only assent to his arguments without being able to add to them.

I believe that we may well accept a speed slightly less than is usual in foreign fleets for the sake of increasing the powers of attack and defense; but when this inferiority of speed is coupled with an absence of torpedo armament while all other nations provide such; then our ships are reduced to a state of hopeless inferiority in every tactical situation in which they may chance to find themselves.

In such circumstances the enemy has the choice of battle, and if he accept it, he has the great moral advantage of torpedoes and the choice of range. If he prefers a close range (under 3000 yards) he forces our ships to fight in retreat, whereas such of our ships as have fire ahead different from the astern, are superior in fire ahead.

As the Scientific American very pertinently observes in a recent editorial, the Connecticut can scarcely be regarded as a first-class battleship because she lacks torpedoes.

Lieutenant-Commander BERNADOU, U. S. Navy.—I have talked frequently with some of the leading opponents to the installation of torpedoes on battleships. I mean by such, those whose will acts as a determining factor in preventing such installation.

Their arguments are the following. They say that before torpedo range is reached the ships of one side or the other will be destroyed by a hail of projectiles; that torpedoes cannot be relied upon for ranges of over 500 yards; that the torpedoes themselves are such complicated devices that their action is uncertain and their range limited; and instances are cited where, through defects in steering mechanism, torpedoes have curved around in their course, so that they endangered the vessels firing them.

Such arguments as above represent no study of battle tactics, where a brief consideration must show that a fleet without torpedoes must run away from one supplied with them; take no account of the distribution of armor on ships that may possibly be opposed to our own, for which there exists, on account of well-distributed protection, a fair chance of more than one ship of a fleet forging ahead to within torpedo range before receiving material injury; disregard the fact that motive power in battleships is heavily protected under deflective decks, so that torpedo armament might remain effective when guns were knocked out; and base objections to torpedoes upon acknowledged defects existing in types of torpedoes now used by us.

Commander Murdock's paper is a timely one; and I can only hope that a number of criticisms, sufficient to reflect the service opinion of fighting officers, will appear in the INSTITUTE PROCEEDINGS.

There is one point that I think Commander Murdock does not sufficiently develop, and that is the support to *morale* that the possession of torpedoes insures. Guns must be sighted and fired by men, whose nerves are under high tension in action. If their ship be torpedoed, they go down with it. Will not superiority in guns be more than counterbalanced by the unsteadiness superinduced in gunners,—and others,—from the knowledge that, when within or near torpedo ranges, they are under the influence of a destructive power against which they have nothing to oppose?

The writer believes, moreover, that range and power of torpedoes is largely undervalued at the present time. This is the epoch of gunnery; we run to fads and are prone to disregard what is not the interest of the moment; hence the power and use of the torpedo is largely overlooked to-day.

If for no other reasons than their moral effect and as a determining factor in battle tactics, the installation of the torpedo on battleships is imperatively demanded.

The only trouble seems to be in getting the higher authorities of our country to appreciate this and order torpedoes installed.

Assistant Naval Constructor T. G. ROBERTS, U. S. Navy.—The absence of torpedo tubes on our battleships is due, no doubt, to the belief, created at the Santiago fight, that battleships will never again fight within close range:. The enemy ran away from our fleet at Santiago, but we managed to run after them fast enough to pick them up at long range; therefore none of our future enemies will ever run at us or get within close range. We always pick up a few fallacies of this kind from the popular idea of what is proved by a battle. The fighting at Manila and at Santiago gave no opportunity for close range torpedo work, but it did not prove there never would be such opportunity in future. The mind is likely to cling more closely to fact, but the fact that torpedoes played no part in the last sea fights need not discredit it as a weapon by unjust judgment on such a class of negative evidence, no more than should the fate of the Spanish torpedo boats prove that torpedo vessels will always be useless as weapons of surprise. From the explosion of torpedoes in the wreck of the "Vizcaya," a certain sense of precaution gained credence in the press and in the service, to a certain extent, and it has been held by some that the presence of a torpedo invites danger to the carrying vessel, of explosion on being struck by the enemy projectile. It was supposed that the torpedo in the bow tube of the Vizcaya was struck by a projectile and had exploded. That was the current report. The Board of Investigation found that no torpedo had exploded in the tube, for the tube remained intact; that the torpedoes in the racks near the tube had exploded from the heat of the flames of the burning vessel; and the precaution suggested is to stow all torpedoes underneath the protective deck, which would seem to indicate the necessity of underwater tubes.

If the enemy should *will* to fight us at close range, and we went to meet them, each approaching at ten knots, it would require 15 minutes for the vessels to meet after beginning the fire at a distance of 5 knots. Will it be a certainty, then, that the enemy fleet will be destroyed in 12 minutes, before they have time to get within torpedo range? If so, our ships have no need of torpedoes. It does not seem possible that we could destroy the enemy ships before they could reach us with their torpedoes.

Let us suppose that we are fighting against a commander of Nelson's ideas, bent on getting as close to us as possible in the shortest time, and the best man wins, all bridges burned behind! At 2000 yards we can justly suppose each fleet to be equally damaged by gun-fire, and when the battleships range alongside, which will win; the ships with torpedoes, or those without? We can only speculate, and form our opinions as best our judgment dictates, but it is presumed the crew would feel more comfortable on the battleship with torpedoes, and would fight in better spirit, in a winning game.

As to the technical difficulties, it does not appear that they have been the guiding feature; but service opinion must be responsible. It seems fortunate at this time that opinions are undergoing a change. It is a question of competition and we must have as good weapons as our enemy in any probable or possible contingency; and most especially in a case where the possibility exists that in our next sea fight, a well-aimed torpedo might equal a battleship.

There may be more potent reasons for the contrary opinion; if so, they are not very apparent.

Lieut. F. K. HILL, U. S. Navy.—The writer is very glad that he has been asked to make some remarks on the paper written by Commander Murdock, because as Torpedo Officer in the Bureau of Ordnance he is in a position to give information as to the objections raised by the Board on Construction to the installation of submerged torpedo tubes on battleships and armored cruisers.

By permission of the Secretary of the Navy, the writer quotes the following letter which gives the objections of the Board, and, also, some arguments against their decision:

"Bureau of Ordnance,
"Washington, D. C.,
"June 15, 1903.

"Sir:

"I have the honor to call your attention to the following facts concerning torpedoes and their installation on future vessels. This I consider my duty to do because as Topedo Officer in the Bureau of Ordnance it is a subject toward which my thoughts are constantly directed.

"The decision of the Board on Construction, to omit torpedoes from all vessels other than torpedo boats, is, in my opinion, a most grievous error and an omission which may cost the Navy and the Country great loss.

"During the year's time I have been in the Bureau of Ordnance many officers have spoken to me on this subject and not a single one, other than a member of the Board on Construction, has spoken in favor of the removal of the topedoes from vessels of war.

"In addition to this, the attention of the Department is respectfully called to the practice in other first-class navies. Not one has omitted torpedoes from battleships or armored cruisers.

"The arguments against torpedoes used by the Board on Construction have been five:

"1st. Because of the limited range of the torpedo (800 yards at maximum speed) it was not liable to be used on battleships.

"2d. Intricate installation and weight.

"3d. The tube being fixed the torpedoes were restricted in direction of fire.

"4th. The element of danger from the inner tube remaining stuck out.

"5th. The element of danger from the large opening in the side of the vessel.

"The first has been overcome in the most modern torpedoes which now have a range of 3000 yards at high speed.

"The second, as far as intricate installation goes, is shown not to be a feature, because foreign services have found them practical if somewhat complicated, and there are many other instruments on board a ship which are equally intricate, the discarding of which nobody would recommend.

"The third objection to fixed tubes is without foundation, since curved fire for torpedoes has been developed.

"The fourth and fifth objections of danger are not obvious. There are no records that tubes have even occasionally stuck in foreign services and the objection to a hole in the side is of no greater weight for a torpedo hole than for the many other holes which already exist.

"In regard to the weight under the second heading: A recent request from the Bureau of Construction and Repair to the Bureau of Ordnance brings up the question of putting torpedoes on 50-foot boats. In a personal interview with the Chief Constructor he stated to me that his Bureau and the Bureau of Steam Engineering were buying a 56-foot boat in England and it was his idea to have similar 50-foot boats carried by battleships and armored cruisers of large size.

"Since the total outfit for these torpedoes will have to be carried by the battleship, it does not seem to me that the saving in weight is sufficient to pay for the loss of efficiency, for the torpedoes proposed to be carried by these boats are small in size and, therefore, have less speed and range than those which would be installed on the battleship proper.

"Again it seems rather odd that after torpedoes were eliminated from battleships because of weight, that it is proposed to carry them on boats which are in turn carried by the battleship, even though the weight of the boat outfit is less than the ship outfit would be.

"The torpedoes carried by the boats would be of no use in a fleet action, whereas, I am informed that in the war problems carried on at the War College the tactics of our fleets are changed, restricted and hampered by the vessels not being fitted with torpedoes.

"Within the last year the range, speed, and accuracy of torpedoes have been much improved, and in addition the development of curved fire has added greatly to the tactical efficiency of the torpedo as an instrument of war, therefore, I earnestly hope that the Department will make a broad investigation of this subject before final decision is given to omit torpedoes in all future battleships.

"Very respectfully,
"F. K. Hill,
"Lieutenant, U. S. Navy.

"The Secretary of the Navy,
"Via Bureau of Navigation."

The writer regrets that on account of the confidential character of recent improvements he is unable to give more fully arguments which would clearly show that the modern torpedo is an instrument of precision and a serious factor as an arm of offense.

Lieut. R. R. BELKNAP, U. S. Navy.—Commander Murdock's article is a timely reminder to the advocates of submerged torpedoes in battleships that silence on their part gives every facility to their opponents to make good their contention, although there is little if any doubt that these opponents are in a small minority. This matter is altogether too important to go by default.

No person with a knowledge of the present state of development of the torpedo can deny that its practicability as a weapon has been successfully demonstrated. It has a real military value, being a menace to an enemy at all times, and also a weapon in reserve, so much freer than even the best protected guns from the damage and disconcerting effects of an engagement, as to have every reasonable probability of being ready for use when wanted, late as well as early in the action.

It has been argued that the present value of the torpedo does not justify its installation; but that, if later it demonstrates its worth, we can then adopt it.

Passing over the consideration that we are putting ourselves in a position to facilitate the torpedo's making such demonstration at our expense—it is plain that the simpler and safer course would include the submerged torpedo installation in the vessels that are building. This would put us on an equal footing with foreigners (since every modern battleship and armored cruiser built or building, except ours, carries torpedoes), and there would then be little difficulty in adopting improvements in torpedo installation from time to time, thus insuring to us throughout the full benefit of whatever value the torpedo may now or subsequently possess.

Even supposing that the only value of torpedo installation in battleships is its moral effect (though this is not conceded for a moment), who can say that we are safe in depriving ourselves of this advantage? We have no instance of a battleship being sunk in an action between fleets, but adequate proof exists that a battleship can be sunk by a torpedo, and it needs no stretch of imagination to picture the demoralizing effect on the others that might result from the torpedoing of one of our vessels in action. The situation would be like that which is so extremely trying even to seasoned troops, of being under fire which they were unable to return.

Similarly, considering the innumerable contingencies of naval warfare, is it safe to deprive our ships of a weapon that every possible enemy carries, because some actions may be decided before the contestants get within torpedo range? To assume that this will cover the majority of cases, we must reject the conditions where darkness, lack of sea room, or thick weather might tend to reduce the range, not to mention the possible case of a vessel with battery disabled, but otherwise capable, closing with an enemy in order to use her torpedoes, or escaping capture or ramming because of them.

Without torpedoes, our battleships have a handicap for which no substituted slight increase in battery or defensive qualities can compensate. Allowing 60 tons as ample for four submerged tubes (Maine's installa-

tion of two tubes weighing about 27 tons), surely the torpedo of to-day has a value in action worth more to the ship than that weight in coal; or, in a ship drawing 25 feet, the additional inch of draft necessary to carry the torpedoes, or a few feet more in length, would be no sacrifice in comparison to the gain in offensive power. To add two 6-inch guns, however, would necessitate placing the gun positions closer together, and would merely increase by a small percentage the total gun-fire, guns being subject to the maximum risk of disablement, by the enemy's fire from which submerged torpedoes are safe.

The torpedo is like the proverbial revolver,—when wanted, wanted badly; the sacrifice in weight to have it is not great in proportion to the size of the ship; mechanical difficulties have been overcome; it is the subject of constant experimenting for improvement; and the possibilities of its successful use are too well established to be discredited.

It is only safe to assume that foreign naval authorities responsible for vessels' designs are as well informed as ourselves on all the torpedo's features, and have given them full consideration from all points of view. Their conclusions result in the uniform practice of installing torpedoes in battleships and armored cruisers. Are our ships enough superior in other respects to foreign ones, class for class, and date for date of *commission*, to justify our contrary course?

Lieut. L. H. CHANDLER, U. S. Navy.—1. It is with the greatest happiness that I see throughout the service at large an ever-increasing sentiment in favor of the torpedo and of its retention on board ships heavy enough to carry the submerged tube. So far as I know, this paper by Commander Murdock is the first public indication of this feeling, and I hope its publication will bring out the very strong feeling in accord with it that I have seen existing among officers of all ranks in the service.

2. I think that the reason for the abandonment of the torpedo aboard heavy ships has never been officially laid down in specific terms, but I was on duty in the Bureau of Ordnance at the time when the final decision was made to omit tubes from all vessels (armored cruisers and battleships) following the Maine class. So far as I know, the arguments that killed the installation aboard those ships were:—

a. The fact that a majority of the Construction Board did not believe in the reliability, accuracy and usefulness of the torpedo or of the submerged tube, or of both.

b. The fact that the installation of the tubes involved a certain amount of trouble from a structural point of view.

3. I think that Commander Murdock's statement of the case leaves little for others to say, from a tactical point of view. It only remains to say that the torpedo and the ram are the only known weapons that give to a weaker force the power to achieve success or even self-defence against a greatly superior force. The two I look upon as supplementary of each other, in that the torpedo simply extends the range of the ram. The abolition of ram and torpedo simply means that it is believed that no

ship will ever be put in a position where, for the honor and safety of the country, her officers and men will be called upon to "die bravely in facing fearful odds." The loss of the only weapons of possible success in a forlorn hope, will eventually mean the loss of the spirit of the forlorn hope, and we will experience to our dishonor the humiliation of surrender or the disgrace of having sent the Nicholas Biddles of the future to their deaths with no more useful results than accrue from the example of brave men uselessly throwing away their lives in hopeless endeavor in order that the honor of their country's flag may not be dimmed.

Lieutenant RIDLEY MCLEAN, U. S. Navy.—The constantly increasing value of the torpedo as a weapon of offense due to (1) its increasing range, (2) its recently wonderfully increased accuracy, and (3) the facility with which it may be fired in any direction from a fixed tube,—both of the latter qualities being due to the perfection of the gyroscope renders the question submitted by Commander Murdock of peculiar value at the present time.

The essay should be conclusive in demonstrating the necessity for torpedoes in our battleships. It deals however, chiefly with the tactical necessity for the weapon, whereas its opponents, while conceding to it a remote theoretical value, base their arguments more on practical considerations as to its expediency, and it might be well to consider these arguments in detail.

The few opponents of the torpedo on battleships base their arguments chiefly on assumptions which it will be noted are as a rule founded on misinformation. These arguments will be touched upon in turn.

1st ARGUMENT. As above-water torpedoes are a menace to the vessel carrying them, they are out of place on board of a battleship, and therefore torpedoes, if carried at all must be fired from submerged tubes which have the great disadvantage of being required to fire from a fixed position of train.

While it is conceded that the submerged tube is preferable to the above-water tube, owing to its greater immunity from danger, the above argument is founded on a lack of familiarity with the methods now used in firing torpedoes. It is founded on the assumption that the tube must be pointed approximately at the enemy when the torpedo is fired, whereas, with the improved gyroscope, it is, so far as I know, a conceded fact that the movable tube is no longer an advantage, and even if supplied it would probably be laid in a definite fixed position, and the gyroscope set to make the torpedo run on the desired bearing from the firing vessel.

According to recent practice on torpedo craft where movable tubes are provided the gyroscope is set so that the torpedo runs approximately parallel to the course of the firing vessel; in this way the torpedo is pointed more accurately than the old method rendered possible, by directing the vessel herself at the enemy; and by firing two torpedoes simultaneously, one from each broadside, a danger space of some 150 yards wide is obtained.

But whether or not this method be adopted, the fact remains that the movable tube is no longer an advantage and this argument against submerged tubes must therefore be abandoned.

The strongest argument which has ever been advanced against submerged torpedo tubes is that their use required the ship to be so manœuvred as to bring the enemy on a fixed bearing, before firing the torpedo, thus obliging the tactics necessary for the gun to be changed when using torpedoes. While this was once a well-founded objection, the recent development of the gyroscope which renders it practicable to fire the torpedo in any direction from a fixed tube, nullifies this argument. This one improvement, (which while rendering this possible also permits torpedoes to be fired in a wide danger zone) combined with the torpedoes' peculiar quality of possessing an absolutely flat trajectory throughout its entire run, has changed the torpedo from an approximate and erratic weapon to a very accurate one; one which cannot be neglected within its allotted range especially in view of its almost certainly fatal effect on the enemy if a hit is scored.

2d ARGUMENT. The development of guns and gunnery renders it improbable that hostile vessels will ever get within torpedo range.

The best that can be said for this argument is that it is based on an assumption, which as Commander Murdock has shown, is not generally conceded. Those who use this as an argument (and it is the most common argument of all) cannot have seriously considered the matter with unbiased minds. Commander Murdock agrees with certain eminent foreign authorities in placing 2000 yards as the probable extreme effective torpedo range. Is modern gun-fire so terrible, marksmanship so perfect, and armor so important that any one really believes that *every* future naval battle will be finished before the ships get within 2000 yards of each other, whether individual engagements or fleet actions? If a reasonable probability exists that *any* naval actions will be finished inside of this limit we should provide torpedoes for that contingency. Many believe that the probability is that in every action the contesting ships will come within the 2000 yard range at *some time during the engagement*. A very great number of officers, both of our own and foreign services, whose opinions are worthy of consideration, think, that while battles will commence at long ranges, they will be finished at short ones; when the many errors which creep into long range gun-fire are considered this seems to be at least a probable hypothesis. It is certainly reasonable to suppose that the upper works of a ship will suffer more in action than her protected vitals, therefore on closing to short range it seems highly probable that there might be a time when the battery was greatly injured and the torpedoes yet intact. Ships will undoubtedly close, due to the initiative of one or the other of the Commanders toward the end of the action; particularly will this be the case if one of the combatants carries torpedoes, and has succeeded in almost silencing the fire from the enemy, and especially if under such circumstances he knows he runs no risk of being torpedoed if he does close in. Not to admit that this is at least *possible*, is, in so serious a matter a very

grave mistake; and, as pointed out above, we should have torpedoes if this is *even a possibility.*

It therefore seems to me that the above argument is a dangerous theory on which to stake the fate of a battleship, the result of an action, and the reputation of the service.

3d ARGUMENT. The inaccuracy of the torpedo renders very slight the chances of hitting an enemy under battle conditions.

This argument seems to be based on the same unfamiliarity with the latest methods of firing torpedoes, as was pointed out under argument 1. That there is no case on record of a large vessel using torpedoes successfully in action, is not really an argument. The torpedo is a comparatively new weapon, especially in its present improved state, and the battles through which it has passed are too few to render this argument of serious weight. Rather must it be considered in the light of what may reasonably be expected of it in its present state of development.

Considering it in connection with the gun, it is practically free from the effects of the incorrect estimation of range, so difficult, yet so essential to accurate gun-fire, as it remains at a predetermined depth below the surface of the water throughout the entire run. It may be pointed by the ship itself (by firing ahead) or by setting the gyroscope at a measured angle with the keel, either of which can be done with great accuracy; it is practically independent of the motion of the firing vessel, and the method of firing two or more torpedoes at the same time, thus forming a wide danger belt, would seem to render the probability of hitting very high when within torpedo range. So nearly exempt is the torpedo from the very many sources of error in gun-fire, that within its own range and with the same attention that is given to gunnery training, it would seem to be quite or even more accurate than a gun at its probable fighting range. Without attempting an analysis of the respective errors of torpedoes and guns, it may be said that with the former the one and only thing to be considered is the motion of the target, whereas with gun-fire there are at least twenty sources of error, most of which we all know are not imaginary.

A high degree of accuracy with the torpedo has been attained in practice. As in gunnery, this degree of accuracy would probably be less in action, but, as in gunnery the performance of the weapon under known conditions proves that the inaccuracy is in the personnel handling it, and is not inherent in the torpedo itself, therefore, exactly as in gunnery, this personal element can be greatly improved by diligent, and intelligent training during peace.

4th ARGUMENT. The disadvantages of the cost, weight, and space occupied by submerged tubes. The intricate design of the mechanism renders accidents liable to occur.

Tactical requirements should eliminate the consideration of cost, so long as it is not prohibitive.

In regard to space, it may be said that practically the installation of torpedoes does occupy certain space which could conveniently, or even

advantageously be used for other purposes, hence their installation may add to the inconvenience of certain storerooms, but it *is practicable* to carry them, and the fact that certain space is occupied by them while possibly adding to the inconvenience of arrangements, in no way detracts from the real fighting value of the ship. Hence if tactical considerations require them, the item of the space occupied is a detail not worthy of weight in a consideration of this question.

As to the question of weight, the entire torpedo outfit for two submerged tubes weighs about 30 tons. This would increase the draft of a 16,000 ton battleship about one half of an inch. As in the above case, if tactical considerations render torpedoes necessary, this is too small a matter to affect the decision, for if they are necessary, that amount of weight in coal, in guns, or in equipment could in no wise compensate for their absence.

The fact that successful torpedo tubes have been designed, and are in constant use at the present time, should eliminate the consideration of intricacy where it conflicts with tactical necessity. The present tubes are capable of accomplishing the results for which they were designed, and therefore, although their care may add to the work of the officers and enlisted men on board ship, this should not be considered as an argument against providing them.

The liability to accident, so long as it does not endanger the ship herself, is no argument. If the presence of the under-water tube *does* endanger the ship the question resolves itself into a specific consideration of whether the danger from them is sufficient to warrant their omission; whether the danger from them outweighs their tactical advantages. Foreign navies, which at the present time possess all of the experience with submerged tubes, have evidently not found this to be the case.

5th ARGUMENT. They may be introduced later when their value has been demonstrated.

This is very true, but it apparently assumes that we are to be witnesses and not participants in the demonstration. An adherence to this principle in the design of men-of-war means that in the event of war we must necessarily be unprepared—still awaiting the demonstration of the value of weapons. The value of the submerged tube, or the torpedo itself, may or may not be demonstrated in a war. If a battleship sank another with a torpedo in a fleet engagement, the popular, non-technical mind would consider that feat proof conclusive of the absolute necessity of this weapon on our battleships, while if a dozen magnificent opportunities were wasted by the clumsiness or stupidity of one man, they would promptly condemn the weapon. To a lesser extent these same considerations affect the technical mind, and we might therefore be actually misled by a torpedo record made in a single engagement, or even in an entire war. The opportunities in war are too few to enable us to deduce a general rule. It is rather what we learn in peace of the *capabilities* of a weapon that should govern our judgment. In peace we become acquainted with a weapon under all the conditions in which it may be used; in war we use it as we can. We *now* know the capabilities of the tor-

pedo, and to a certain extent (which experience will improve) of the submerged tube, and further waiting for a battle demonstration is not logically sound. It is basing an important feature of *preparation for war* on the success or failure of a few possible trials, which any one of fifty things might seriously affect.

As Commander Murdock forcibly points out, torpedo tubes will probably never be introduced after the completion of a battleship, and if so, it will be done only at a very great inconvenience and expense. It may be added that this inconvenience and expense will probably never be incurred until after a battle, and probably a defeat, proves the necessity for such a departure.

In conclusion, my firm conviction that the omission of the torpedo from our late battleships is a serious mistake is based on the following assumptions:—

1. That torpedo fire can now be directed from the fixed submerged tubes, with the same facility and accuracy as from above-water tubes capable of being trained. Therefore the presence of such under-water tubes does not tend to change the tactics of a fleet any more than the guns do.

2. That it is highly probable, owing to one cause or another, that in future battles, battleships will get easily within effective range for modern torpedoes, at some time during the engagement.

3. That within their range of 2000 yards, with the improved gyroscope and the present methods of firing, the torpedo is an accurate weapon.

4. That one hit from a torpedo is probably more effective than numerous hits from even the heaviest guns.

5. That if the above is admitted, the addition of any number of smaller guns would not compensate for the absence of a submerged tube in each broadside.

6. That no appreciable tactical advantage is gained by their omission.

7. That other things being equal, the ship with submerged tubes will, in individual action defeat one not so equipped; and in a fleet action would be vastly more valuable as a fighting unit.

The thanks of the service are due to Commander Murdock for presenting this subject to the INSTITUTE for discussion.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SCOUTS.

Lecture delivered by Capt. C. F. Goodrich, U. S. N., at the Naval War College, Newport, R. I., July 20, 1902.

In a lecture on Naval Scouting read at the College, June, 1899, Commander Murdock happily remarked that "the knowledge of the position of an enemy is the starting point of all successful operations against him." I commend this lecture to your reading, for it presents my subject to-day in a light somewhat different from my own and supplementing what I have to say, it permits, on my part, a brevity which I am sure will be gladly welcomed by you all.

For the benefit of those who may be unable to study Commander Murdock's paper, I venture to repeat his recommendation to practice scouting on paper, as in our game of strategy here, and thus eliminate certain methods which seem inevitably doomed to failure. A striking analogy, by the way, between constructive engineering and the conduct of war is found in the larger employment of graphic analysis in both cases. Just as we at the College lay down our operations on charts, so do engineers design roofs and bridges by drawing lines on paper. The day has passed for elaborate and time-consuming computations. This is true although engineers still calculate the strains and stresses in novel designs and although we use the curves of search, but chiefly for the purpose of determining the limits of the area within which it is profitable to scout for an enemy.

While it is inadvisable to lay down hard and fast rules, experience in fleet manœuvres has shown that it is well to scout in couples in order that one vessel may keep in touch with the enemy while the other reports—for it is just as important to tell of what is seen as to do the seeing.

How far this requirement may be modified by wireless telegraphy will depend upon the development of this new art, an art destined to increase the radius of a scout's activity to an extent, at present, we can only surmise. For we do not yet know the distances over which a scout may speak and be heard. When a future Marconi or a Becquerel shall devise a means for seeing as far as the wireless message may be heard, the game of scouting will be vastly simplified and secrecy of movement on the sea a thing of the past. At present, successful scouting depends first of all, upon a happy inference as to the enemy's objective, secondly, upon a skilful deployment of the scouts available. It is a truism that you may scout thoroughly over an area proportional to the number of vessels at your disposal or less thoroughly over a wider space. The choice must rest with the commander-in-chief who will be aided by a multitude of considerations affecting the objective, the geographical features of the theatre of war, coaling stations, and the bases primary and advanced. As I have said already, more can be learned from patient playing of our game of strategy than in any other way of which I have knowledge.

In order to fully appreciate the importance which scouts and vedettes possess in warfare, it will only be necessary to place yourself in the position of the Admiral in this year's problem and ask "What should he do?" to perceive that for the correct employment of his fleet he must rely upon the intelligence brought to him from the sea. It is entirely probable that he has had timely notice of the contemplated or actual sailing of the enemy, the news being transmitted by telegraph and it is not impossible, also, that through spies and other channels he may be somewhat forewarned of the enemy's objective. To act upon such reports alone would be to venture everything upon one throw of the dice. In spite of the strong likelihood of their being true there is always a chance either of their being false or of a change in plan on the part of the enemy after his departure. Our admiral must have all such stories to weigh, and to accept or reject as his judgment dictates, but since the responsibility of action is his solely, he must furthermore be in a position to know, at short intervals, not so much what the enemy is thought to be doing as what he actually is doing. Once the enemy is clear of his base, the admiral has but his own re-

sources to rely upon for learning of the enemy's movements and his own shrewdness and insight to penetrate the enemy's intentions. The earliest stages of the enemy's advance will reveal little, but surmise will gradually give place to certainty as the hours and days pass by, and the enemy draws nearer, provided his progress be steadily noted and reported.

On the other hand, if our admiral be supplied with lookout vessels, inadequate in numbers or of indifferent speed, he will be more or less in the dark as to the enemy's movements and will be chained to his base by his ignorance of the probable point of attack, no matter how powerful may be his fleet or how urgent the call elsewhere. He cannot go blindly upon a pure guess at the objective, or, if he does, he will quite likely find himself remote from the place of assault where the blow will have been delivered and the damage done before he can interpose. Such impotence would be pitiable if it were not even more reprehensible from the military point of view and it can be prevented in one way and in one way only, through the possession of sufficient scouts of a proper type. It is indeed not too much to say that a weaker fleet, abundantly provided with lookout vessels, is more formidable than a somewhat stronger fleet, ill or scantily so provided.

What should be the characteristics of the vessels detailed for this service?

Unquestionably there are three vital requirements, speed, seaworthiness and great coal endurance. Other attributes that may be possessed are but supplementary. Thus a light battery would be useful in case of falling in with an unarmed despatch boat or transport, but it would be unwise to permit a scout to undertake any enterprise that would interfere with its own clearly defined duty to observe and to report. It is not meant to deprive a scout of all powers of resistance; on the contrary, while relying chiefly on her speed to escape an enemy's cruiser she should not be so defenseless as to fall, in case of a mishap to her motive power, an easy prey to a more insignificant craft better armed. But I wish to emphasize the desirability, as I understand it, of completely separating the role of the scout and that of the cruiser. Compromises are proverbially dangerous. It appears to me injudicious to unite in one vessel duties of such conflicting natures. The temptation to engage an enemy, if

comparatively equal in force will always, let us hope, prove very great, but this temptation must be ordinarily resisted, and especially so when, by yielding to it, the bringing to the admiral of intelligence of an important nature may be jeopardized. I am not referring to such a reconnaissance executed by swift and powerful cruisers as may be directed by the admiral in order to ascertain the enemy's strength, a reconnaissance whose analogue is found in the military art and which not infrequently is but the prelude to battle. This is an entirely different matter, and it must not be confounded with lookout duty pure and simple.

Having deliberately decided to sacrifice armament and armor in order to secure other qualities which in our opinion are more useful in this special work, what existing vessels present these qualities in their highest development? Without doubt, the fast mail steamers.

Happily there are four now flying the American flag which can be had in case of war and which are almost without rivals in capacity for this employment, a capacity proved beyond peradventure in our last war. I mean, of course, the *New York, Philadelphia, St. Louis* and *St. Paul*. They are able to make 20 knots at sea and to maintain that rate as long as their fuel lasts. By filling their hold spaces with coal their endurance becomes phenomenal. Their great size (the *St. Louis* displaced 17,250 tons when she left New York, on May 29, 1898, the *New York* and *Philadelphia* are somewhat smaller) gives them a power to keep the sea and to operate in all weathers whose value is really beyond estimate. The Ward Line, the Savannah Line, the Old Dominion Line, etc., possess steamers of 16 knots and upwards which may be drawn upon largely to increase the number of our scouts. The following list is presented for your consideration:

AMERICAN MERCHANT STEAMERS HAVING A SPEED OF 16 KNOTS AND OVER.

Atlantic.

Name.	Gross tonnage.	Owner.	Remarks.
New York	10,674	Int. Nav. Co.	
Philadelphia	10,669	Int. Nav. Co.	
St. Paul	11,629	Int. Nav. Co.	
St. Louis	11,629	Int. Nav. Co.	
Morro Castle	6,004	N. Y. & Cuba Mail S. S. Co.	

Name.	Gross tonnage.	Owner.	Remarks.
Havana	5,667	N. Y. & Cuba Mail S. S. Co.	
Mexico	5,667	N. Y. & Cuba Mail S. S. Co.	
James S. Whitney..	2,707	Metropolitan S. S. Co.	
Jamestown	2,989	Old Dominion Steamboat Co.	
Jefferson	3,127	Old Dominion Steamboat Co.	
Kansas City	2,679	Savannah Line.	
Plymouth	3,779	Old Dominion S. S. Co.	

To these would be added, after simple alterations, to make more seaworthy:

Monmouth	1,440	C. R. R. of N. Y.	
Sandy Hook	1,559	C. R. R. of N. Y.	
Alabama	1,939	Baltimore Steam Packet Co.	
Georgia	1,749	Baltimore Steam Packet Co.	

They lack size for extended service.

Pacific.

China	5,060	P. M. S. S. Co.	
Victoria	1,504	N. A. Mail S. S. Co.	
Gov. Dingley	3,826	Portland S. S. Co.	
Queen	2,728	Pacific Coast S. S. Co.	

Several splendid ships building may be added to this list.

In comparison with such vessels our naval cruisers are hardly worth mentioning, for their coal endurance falls far too short of the desired figures, and their sustained sea speeds are much below the maximum trial speeds at which they stand nominally rated. Some of them, such as the *Detroit* and *Cincinnati* class, are lamentably deficient in bunker space and some again, are too small to be efficient in heavy weather cruising. Moreover, being built with a view to fighting they are too valuable to be diverted to this non-fighting service. They will be better utilized in other ways. My contention is that special work should be done by special tools and that this non-combatant function should be assumed by effective non-military constructions.

Having determined upon adopting swift staunch merchant steamers for scouting, the question immediately arises "How shall they be manned and commanded?" There are several things to be taken into consideration in this connection. It might, and naturally would, seem best to commission them regularly and put naval officers and naval crews on board. But to this obvious course there are several objections. In the first place our own ships, as we know from our experience in 1898,

will absorb all the available men at our disposal, and oblige us, in addition, to call largely for volunteers to supply the deficiencies. In the second place, our own people would have much to learn in the way of caring for an unfamiliar type of ship and of getting out of her machinery its maximum sustained effort. It would be, as I see it, far wiser to take them over with their complements as they stand, excepting the unnecessary excess in the steward's department, enlisting their men under special agreement and issuing temporary commissions to their officers. Some modifications in the navy pay table and much avoidable departure from naval routine and discipline must be authorized by the Navy Department in order to accomplish the transfer of control from the proprietary company to the government, without producing friction and discontent and without weakening the steamer's crew by the withdrawal of desirable persons. A small contingent of man-of-war's men would be placed on board, barely sufficient to care for the signals, battery and arms with which the scouts would be furnished and to serve as a nucleus about which the steamer's deckhands, if necessary, would crystallize into gun's crews.

On board the *St. Louis*, where our armament consisted at first of four six-pounders, afterwards eight six-pounders, and four 5-inch R. F. guns, the battery was manned by marines. I may say that what I am now advocating is what I advocated before 1898, and essentially what I practiced during that year. After the second of my three trips, the officers were commissioned, but the crew was always a merchant crew, shipped and discharged by the Shipping Commissioners of the port of New York. The pre-Elizabethan manning was revived. I commanded the ship as a whole. Captain Randle of the American Line was my sailing master and the chief of the navigating element. Ensign Frederick R. Payne, U. S. N., was my aid, and the military, forty marines, was commanded by Lt. A. G. Catlin, U. S. M. C. Except in providing a powder division under Chief Officer Segrave, the sailing element had no military duties whatever, at least on paper, but, as a fact, they went heartily into every bit of fighting which arose.

On reaching New York, the whole lot of the enlisted force was discharged outright, to be reshipped the morning of sailing. Far from this being a drawback, we never lost a man we wanted

and as we pushed out into the stream we left four to six hundred men on West Street clamoring to be taken along.

And the command? Shall it be retained by the previous skipper? Shall it be given to a naval officer detailed for the purpose?

There are but few among us who have had the rare experience which once fell to my lot in 1884, to command a vessel flying the American flag and pennant, yet manned exclusively by merchant seamen. My cruise was not a long one, but it was long enough to convince me of the wisdom of the course I adopted at the outset to confine my orders to the thing I wanted done and to shut my eyes to the method by which it was accomplished, unless, of course, the method should appear to be dangerous. And so, with a British merchant crew, using British merchant steamer ways, I made my trip across the ocean without friction or discord of any kind. I gave my orders to the first officer or officer of the watch and observed with keen, and occasionally amused, interest the process of execution with which, as a matter of fact, I had never occasion to interfere. This episode served but to confirm my belief that it will entirely suffice if we place on board of each scout an officer in general charge, responsible for the movements of the ship and for the work she performs but absolved from all the minuter cares of routine and discipline, leaving such matters in the hands of the merchant captain.

The officer in charge of such a merchant-manned scout must be selected as well for his discretion as his ability. Numberless occasions will arise when the exercise on his part of that rare quality, tact, will further his ends and avoid petty and needless friction.

I am informed by the port captain of the American Line that of the four big liners, the *St. Louis,* the only one which did not adopt navy enlistments and routine, made more miles, did more work and more kinds of work, cost less in operation and returned in better order than any of her sisters. I have no reason for questioning the accuracy of these statements; they agree indeed with my general impression, and I have no hesitation in accounting for them by the soundness of the system adopted exclusively by the *St. Louis.* I may add that a happier set of officers or a more contented lot of men could hardly be found.

The record of the ship is notable. She spent six weeks at sea without taking on board a ton of coal, a gallon of water or a pound of provisions, during which period she scouted, captured blockade-runners, landed Shafter's army, housed and fed at one time as many as two hundred sailors detached from the fleet for this landing service, cut cables, and brought seven hundred of Cervera's men north as prisoners.

While suggesting the foregoing as the best solution in my opinion and one founded on an interesting and valuable experience, I do not shut my eyes to the fact that another and opposing view may be properly and strongly held, viz., that the naval officer should take an active part in the navigation and the discipline. If this other view is adopted, then the naval officer will be abundantly occupied in caring for his ship and crew, and an additional officer must be detailed to superintend drills and exercises and to supply, in scouting, that technical knowledge of our own and the enemy's ships, their build, rig and appearance on the water which is essential to efficient work.

As a matter of course, scouts should be supplied with exact descriptions and drawings of every ship in our own and the enemy's fleet, including as far as possible transports and auxiliaries of every nature and with photographs wherever obtainable.

Like the signal book, this information should be capable of instant making away with through sinking. Besides the regular signals, every scout should have a private flag by which she and the service she is engaged upon may be known and she should display a despatch flag to prevent her being unwarrantably interfered with by a senior officer when actually carrying intelligence of a vital character to the admiral.

Among her men-of-war's men there should be a quartermaster and some signal men. A complete equipment of signals both for day and night work is a matter of course. If practicable she should carry a searchlight to be used under exceptional circumstances only, for the searchlight is well known to be a two-edged sword quite as likely to help as to hurt an enemy when displayed without great discretion. The scout of the future will also be fitted with synchronized wireless telegraphic apparatus to obviate the necessity of her return to visual signal distance. The far-reaching influence of this device cannot now be estimated.

During the first trip of the *St. Louis,* from April 30, to May 26, the naval officers and one or two marines made and read all signals for me. On leaving New York, May 29, I had four midshipmen of the third class whom I made signal officers. I think no one can justly accuse the *St. Louis* of slow or ill-defined signaling; on the contrary, the ship was complimented on her excellent performance under this head.

Our masthead lookouts were four in number, selected for their keenness of vision. They did no other work. I am disposed to suggest the adoption of this plan in the navy, for it proved uncommonly successful in my merchant ship command.

In all essentials, what I have just read to you as, in my opinion the wisest course to pursue in utilizing merchant vessels as scouts is what I thought and expressed in 1895, when nothing seemed more unlikely than that I should soon be called upon to command one of these very scouts in time of war. To my views, formed after careful study, I held without variation and I was permitted, during the campaign, to retain the *St. Louis* merchant ship organization intact, save that the officers, late in the day, received commissions.

The scouts of the squadron, as has been said, should be under direct control of the Fleet Intelligence Officer. Their rendezvous and base should not be changed until the development of the campaign renders such a change imperatively necessary. And it might be well to have an outlying *stationnaire* to which reports would be brought, for transmittal thence by swift light-draft craft or by wireless telegraphy to the base, if there be a base. In this way the services of a large vessel would be lost as little as possible from the outer line, the general underlying notion being to keep such steamers well to the front, covering the intermediate stages by smaller ones that could quickly take refuge at the protected base, when seriously threatened.

Please bear in mind that I am contemplating our playing the defensive role.

The circumstances of attack will always be a determining factor in the distribution of the scouts and no fixed rule can be laid down to cover all cases. Scouts have been thrown out on radial lines—spread out fanwise; or sent out in couples, about twenty miles apart, covering a parallelogram of which the fleet occupies a fixed point; or stretched across a channel or a well-

known sea route. Each way is good for some particular combination of conditions; the selection of the way is the responsibility of the commander-in-chief. An enemy having no base on the eastern shores of this continent, for example, might appear off any one of our coast cities or at any point from Eastport to Cape Henry. It will be necessary in case a movement against our Atlantic freeboard be contemplated to place our scouts in a long line between and off these extremities, and with every available merchant steamer pressed into the service, there will still remain gaps to be filled perforce with our cruisers.

Nor will one line suffice. Further in towards the coast there should be another, so that if the enemy should succeed through darkness, fog or thick weather in passing the outer line unobserved, he may yet be detected and reported. Where should the line be drawn?

Some assumptions must be made to obtain data for our arithmetical problem. Let us, acting on the defensive, place our own fleet in Nantucket waters. The distance thence to Cape Henry is a little under 300 miles. If our heavy ships can with pressure make a speed of 12½ knots, a speed which is not unreasonable, then our admiral must have at least twenty-four hours of unobstructed steaming in order to reach the Chesapeake before the enemy. If the latter comes from the southward and eastward of Cape Henry and at the rate of 10 knots he must be say 300 miles distant when our admiral starts from his base. If our scouts can make 16 knots, and it would be venturesome to count upon more, they must leave the enemy to proceed towards the admiral in time to give the latter his required 24 hours and at the moment of their starting they will have ahead of them a journey of 500 miles, or about 30 hours, when the enemy will be 30 hours still more distant from the Chesapeake or 600 miles in all. You will see at once that our scouts must therefore extend from off Cape Sable in a line about 1000 miles long roughly parallel to the coast until it falls into a circle described about Cape Henry as a center with a radius of 600 miles. Giving each scout 20 miles to cover, 50 would be needed in this line alone.

The inner or second line must be at a distance from the outer, equal to about 12 hours' steaming, so that if the enemy dodges the outlying scouts just before dawn of one day he will reach the second line in broad daylight. It is not generally known

that our vessels towards the close of the rebellion were stationed off the blockaded ports, such as Wilmington, in zones so that a blockade-runner was certain to cross at least one zone of daylight between Nassau and her destination. My suggested placing of the inner line of scouts is based upon the experience of our Civil War.

It has been suggested at the College to make one line do double duty, by heading all the vessels towards the coast at dusk and steaming in that direction at a rate estimated to be about that of the enemy until daylight, when a second turn of sixteen points is made and the scouts return to their original station. This scheme commends itself to my judgment when the weather is clear, but at other times, I think a second line preferable as doubling the chance of picking up the enemy. It is highly probable, however, that our lack of sufficient scouts will force us, whether or no, to adopt the alternative plan mentioned.

I have purposely chosen an extreme instance in order to impress upon your minds the fact that scouting may be a vast undertaking, requiring ships of suitable character in large numbers for its thorough execution. In the case cited, the gist of the matter is the number of miles one scout can cover. If kept stationary or nearly so, 20 miles would appear to be the maximum. The same results might be achieved by letting all the scouts steam at the same rate of speed, going south along one line and returning north along the other. At the uniform rate of fifteen knots for example, each spot would be traversed once in four hours if the scouts were sixty miles apart. In this way sixteen vessels actually on the outer line would do the work of fifty hove to, but a certain excess would be needed to take the places of scouts absent for coaling. Allowing twenty-four hours in port to each scout in turn for this purpose, six additional ones would be required besides those on their way home to the base but still at sea. Economy of fuel at such a time would be less important than economy of ships, and this cruising patrol appears to me on the whole, preferable.

The most cursory reading of the reports of foreign strategic manœuvres, some of which have been the subjects of your study, reveals the paramount value of lookout vessels.

The simulated attack of the French Mediterranean Coast in 1888, was successful largely through the lack of scouts in the defense fleet.

In G. I. O. S. N. I., No. VIII, we read that—

"Admiral Hornby gives this insufficiency of cruisers as the first lesson taught by the manœuvres and says that if Admiral Baird (A) had had more scouts he would have learned that a force had escaped from Bantry Bay and would have laid measures accordingly."

The French manœuvres of 1893, in the channel are of interest as showing the value of cruisers. The defending squadron B, having been obliged to give up the chase of A, through loss of scouts.

And again we may gain a hint from the Italian manœuvres of 1893. A critic in the Rivista Marittima of the method adopted for scouting, approves the Duke of Genoa's plan—a torpedo vessel as scout—with torpedo boats to transmit intelligence.

"It was in this manner that the Duke of Genoa employed his scouts and torpedo boats to the greatest advantage. The important information resulting from their operations reached just when it was most needed..... The news obtained by them was transmitted by means of torpedo boats, the latter showing themselves to be better adapted to that kind of work than the actual duty of scouting."

I have in a former lecture dwelt very strongly upon the excellence of swift mail steamers for this duty. That I have not exaggerated is shown by the results of the British manœuvres of 1885.

"The *Oregon* (Cunarder) was found to be of great value to the fleet as scout and in a variety of other duties requiring despatch."

I have not hesitated to claim for scouting an importance in strategy second to no other branch. If all other evidence in support of this radical position were absent, I should rely for your substantial acceptance of this extreme doctrine, upon the experience you have had in our recent fleet manœuvres* and in the strategic war game, an experience which carries with it a conviction I should not dare to expect from my own words. In my next lecture I propose giving illustrations from naval history, including some from our own, for I cannot escape the conviction that our practice in this art has been, invariably, deplorably faulty.

* The writer hopes for an expression of opinion on the part of some of the officers who had to deal practically with the subject of scouting last winter off Porto Rico.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE JANE NAVAL WAR GAME IN THE SCIENTIFIC AMERICAN.*

By LIEUT.-COMDR. A. P. NIBLACK, U. S. Navy.

As I understand naval war games, they are valuable in formulating hypotheses, which may subsequently be tested by other games, or by actual manœuvres, but the most we can say for the results is that, after carefully tabulating hundreds of games, we can get only approximate values. For instance, in tactical games between fleets, we can calculate whether an advantage of two knots in speed is worth a certain number of ships or only a certain fraction of one ship, the units of both squadrons being, of course, assumed to be of the same value; but we cannot tell much by one game or by ten games. In duels between ships or groups, we can assign varying loading intervals, penetration of armor, different values for different kinds of projectiles, or we can test the value of speed *versus* advantage in turning, and, from the results of many games, get certain faint suggestions. In the strategic games, we can test steaming radii, curves of search, methods of scouting, and become familiar with distances, ocean currents, cable stations, favorable strategic areas, etc., and this without the expenditure of a pound of coal or a gallon of oil, other than in the class room. To be more specific, we can test ships' qualities and armaments by the duel, tactics by the tactical game, and strategy by the strategic game.

Mr. Jane's Naval War Game, as outlined in the *Scientific American*, looks to me a bit like one of those "get-rich-quick" schemes

* By the courtesy of the editor of the *Scientific American*, the Institute has been authorized to reprint this game and it will be found following this article.—THE EDITOR.

The duel, the tactical, and the strategic features are all rolled into one, and are accompanied by a realism that lends itself particularly to publication.

Naval war games in general are, I imagine, rather prevalent in well regulated navies, but, even in class rooms, the political features are usually discreetly cloaked under such names as Reds and Blues, and it is not even considered necessary to record the names of the players, because it takes numbers of games to get reliable results, and tabulating data is dry work. What good is therefore to be accomplished by the political twist which has been given this particular game I fail to see. One swallow does not make a summer, and this one game represents largely the personal equation of certain players and certain umpires. To be of any considerable value as data, it would be well to have tabulated the results of numerous games with many different players. In publishing only this one game, there is a certain *naïve* suggestion that the rugged, practical seagoing officers of the British navy are discovering that there may be something in these class-room methods. The establishment of an office of naval intelligence and a naval war college in England are signs in themselves, but surely Mr. Jane does not imagine there is going to be at this late day in either of the two particular navies involved in his paper any considerable demand for his particular game, when they have both been using for many, many years methods which are undoubtedly better perfected than the one offered. I have not the slightest intention of being uncomplimentary or disrespectful to Mr. Jane or to the Portsmouth Naval War Game Society, but it seems desirable to put this particular exposition of the game just where it belongs, for, if it is the forerunner of a flood of harrowing details from the naval tactical dissecting rooms, we might as well forestall the popular effect with a little ice water.

Never having taken the course at the Naval War College, nothing that I can say represents anything more than my personal opinions, and makes it quite unofficial and purely personal. Deeply interested in my own branch of the service, and warmly friendly to other naval personnel involved in this paper tragedy, I shall concern myself only with the methods and details of the game as depicted, without any consideration of the nationality of the ships, feeling sure that what I say will be cordially received on both sides.

Mr. Jane's narrative ends up with the statement that "the umpire's report was to the effect that, though other strategical dispositions might have been made, those undertaken were carried through very well and (taking all circumstances into consideration) without very serious errors on either side."

There are no objections to be urged on my part to the strategic dispositions, or to the "general idea" as outlined, or to the rules under which this particular game is played, or to the decisions of the umpires, and, moreover, all the contributions of Mr. Jane entitle him to be recognized as a "naval expert" in the best sense of that much abused newspaper term. The assumption that we (the A fleet) have the wireless telegraph installations is very favorable, since we have not yet entirely achieved this, whereas the B fleet is well equipped. In the matter of general orders, cruising and scouting formations, recognition signals, blockading instructions, temporary bases, fleet supply, the disposition of auxiliaries, and special orders, the A fleet may well be assumed to have a well digested system, the fruit of the genius of the late Rear-Admiral W. T. Sampson, U. S. Navy, who, on the day he hoisted his flag on the North Atlantic Station, stood easily at the head of the naval profession. Time will confirm his title to this distinction, nor will it be limited to the particular navy of which he was the brightest ornament.

My remarks will be confined to the tactical questions involved in the game, and to the defects pointed out in our *matériel*. In the fleet engagements known as:

I. The Mid-Atlantic Cruiser Action;
II. The Battle of Cape Bojeador;
III. The Battle off Manila;
IV. The Cruiser Night Action off Manila;
V. The Operations off Kiao Chau;
VI. The Second Action off Kiao Chau;
VII. The Final Battle of the War;

I shall inquire into the reasons for handling the two squadrons on principles of tactics so utterly at variance with those popularly accepted in our own service, but particularly as to the A squadron (our own) in (a) the method of the advance to the attack and (b) the division of the squadrons into fast and slow divisions to operate separately.

In a recent paper of mine on "The Tactics of the Gun," read

before the Society of Naval Architects and Marine Engineers, and republished in the PROCEEDINGS OF THE NAVAL INSTITUTE, I claimed that:

"The key to modern fleet actions is concentration of gun fire . . . Fleet formations should be based on gun fire, and, in battle, we should limit tactical movements to those which least disturb it. The object of all tactical manœuvres or movements of a fleet, previous to or in a fleet engagement, should be:

"1st. To get and keep the enemy within effective range.

"2nd. To endeavor to get a *Superior Position* in order to mass some of his fire or increase the effect of your own (or to prevent masking your own).

. . . . . .

"6th. To concentrate gun fire on certain ships of the enemy in order to reduce the tactical efficiency of all his ships by crippling one or more.

"7th. But of all things to deliver a rapid crushing fire at the earliest possible moment, thereby injuring at once his initiative and increasing your own offensive power in a geometrical ratio as you destroy his."

The rational method of the *approach* to the attack is in line abreast at right angles to the bearing of the center of the enemy's formation or to that part of his formation which it is proposed to attack by concentrated fire—because you thus bring all of your broadside battery at the same instant to the point where it is available for use, and at the same time you do not have any portion of your formation idle and exposed to the fire of the enemy. Moreover you have all your bow fire engaged. This in no way implies that line abreast is the formation for *attack*, but to wander into action in column, as is almost always the chronic habit of the A squadron, or to fail to meet the on-coming enemy's column (line ahead) with a proper formation, is to fail to take the superior position, and to lose the initial advantage of beginning the action more or less on your own terms. If one squadron, say A, approaches in line abreast at right angles to the enemy's column, B, then A has all his bow fire (20 to 30 per cent of a broadside) available in its maximum volume for concentration on the leader of B's column, which leader masks the fire of all ships astern and has only his own bow fire available. One would say that in real action anyone would be foolish to make

such an elementary mistake, yet in the engagements narrated by Mr. Jane, the A squadron continually wanders into action in one or two columns with its leading ship or ships at times exposed to the B squadron's almost entire broadside fire. These are extreme cases, but the principle is there, because, given any angle of approach for B's squadron, A can nearly always take a formation approximately at right angles to B's and either force B out of column or turn the head of it. Superiority of speed will, of course, count in securing the best angle of sunlight on the opponents, or best point to make the approach, and this I hold to be the object of tactical manœuvres previous to the approach, but the slowest kind of a squadron can meet an approaching column in a way to force it out of column, or turn its direction with heavy loss to it, by simply approaching in line abreast.

Effective concentration of fire is necessary on the nearest ship or group of ships of the enemy. If two equal squadrons approach each other in parallel lines, neither has any marked advantage or disadvantage at the outset, and all then depends on the next move, but if one of the squadrons approaches in anything else than line abreast, the one in line abreast has the initial advantage in being able to concentrate on the nearest ships of the enemy, for *some ships must be nearer than the others*, if the formation is not line. This appears to me to be elementary and axiomatic, and if the Portsmouth Naval War Game Society will try a dozen games, they will subscribe to it, but I suspect that they know it already.

Nor do I mean strictly line abreast in the rigid sense. The essential thing is that the line of bearing shall be as nearly at right angles to the bearing of the enemy as practicable, but the formation may oblique as much as six points to the right or left in compensating for the change of bearing of the enemy or for small changes of course on his part. To make this clearer:

All simple formations which have any rational relation to gun fire are based on two considerations: (a) course steered and (b) compass bearing of the guide in the formation. In the illustration the course steered is north, but the different formations are "lines of bearing" in which the bearing of the guide, G, differs by two points (22½°) from west (in line abreast) to north, in column (or line ahead, as the British call it). In other words, (a) the course is fixed at north, and (b), the line of bearing, changes, If in line abreast, (a) course north, (b) guide, G, bearing west,

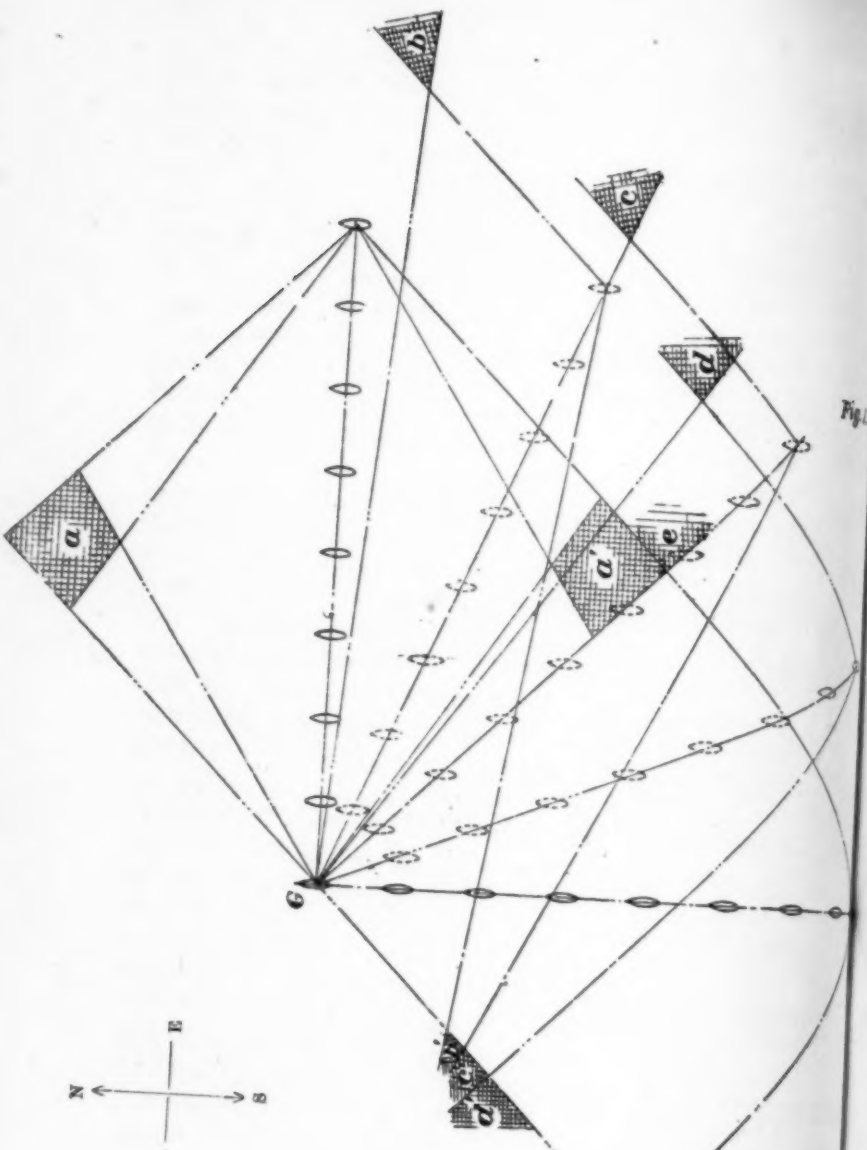


Fig.

the course is changed to NE., the formation would be simple echelon. Strictly speaking, the designations, line, line abreast, column, line ahead and echelon are mere tactical relics. The essential things are courses and bearings, because as guns are limited by arcs of train (approximately 45° forward and abaft the beam) and under-water (submerged) torpedo tubes are limited by fixed installations, we should rewrite our tactical books and throw out most of the evolutions so pleasing to spectators and useless for fighting. In the diagram (Fig. 1), the area of maximum concentration of gun fire for the starboard battery is shown in b, c, d, and e, and for the port battery in b′, c′, d′, and e′. With the starboard battery, a gradual change of the bearing of the guide throws this "area" along a curve of which b, c, d, and e are ordinates, while on the other hand, the port battery changes its "area" positions very little. The inference is that the guide, G should be on the flank nearest the enemy in order to least disturb gun fire in necessary changes of formation (i. e., bearing). In each of the four quadrants of a circle about G as a center of radial "lines of bearing," the port battery will alternate with the starboard in being the effective or better battery. This is all sufficiently elementary to need no further elaboration, and sufficiently axiomatic to say that in the war game under consideration it has not been clearly grasped.

I am not claiming that anything I have said, or will say, would necessarily win a battle on the high seas. Contiguity of land, considerations of the objective, the presence of impediments in the shape of colliers and supply ships, or the strategy of the campaign would all or singly have a different bearing on the tactics preliminary to a reconnaissance in force, a skirmish, or a pitched battle. Admirals are trained at war colleges and otherwise to meet these contingencies when they arise, and all I have said so far is, in the *approach* to the attack, bring your artillery into action according to artillery tactics. Once within the zone of fire the real tactical problem begins, but if you do not approach in line the chances are you have sacrificed the initial advantage.

As regards the other consideration of dividing the A squadron into two divisions, the faster and slower, there is no fault to be found, except that in the approach, and, until your opening comes, said approach is usually not made in separate divisions, and above all not in columns of separate divisions.

In the comments which are here made on each of the separate actions, enough has been said to make the criticisms unmistakable in their meaning and challenging to the tactics used.

I. The Mid-Atlantic Cruiser Action.

In the diagrams showing "Position at Open Fire" and "The Second Stage," the manœuvres of the B squadron, as indicated by lines and arrows, are all that could be desired, considering A's formation. Having under-water-discharge tubes in all but one ship, B is willing to try issue at close range. The tactics of the A squadron would probably have resulted in a court of inquiry, but as this is a realistic game, the A admiral was umpired killed, but if he had lived, he would have probably rested his lame defense on the fact that his government did not supply his ships with under-water-discharge torpedo tubes. As to the division of the A squadron into two divisions (not necessarily manœuvred separately) a better disposition would have been, the Minneapolis, Columbia, Cincinnati and Raleigh in one, and the Olympia, Detroit, Marblehead and Montgomery in the other, with either the Olympia or Minneapolis as flagship, but with the tactics pursued the battle was lost from the start. Considering date of design, homogeneity, speed and armament (including submerged torpedo tubes), an impartial observer would lay his money on the B squadron, but, if the B were manœuvred as was the A, he would lose it just the same.

II. The Battle off Cape Bojeador.

"When the fleets sighted one another they were about 11,000 yards apart, and both were in two divisions line ahead." This "two divisions line ahead" is a good cruising formation, but a very bad battle habit. The B squadron is again handled admirably, in column, awaiting the approach, having the superior position, and again the A admiral wanders in in two columns, and is umpired killed, hit in the conning tower, so to speak; so another court of inquiry and a Bing tragedy is averted. As the text-books say "the diagrams explain themselves," but to make it clear once more:

Assume that the B squadron manœuvred in column, as shown (an excellent disposition, as stated above, and the superior position), and brought to bear all the guns of one or the other bat-

tery, and also assume that the A squadron approached in line abreast; we have

B SQUADRON'S BROADSIDE.

Caliber	9.4-in.	8-in.	6-in.	4-in.	3.4-in.
Number of Guns	4	4	20	5	19

A SQUADRON'S BOW-FIRE.

Caliber	13-in.	12-in.	10-in.	8-in.	6-in.	5-in.	4-in.
Number of Guns	2	3	2	12	7	4	4

In an artillery duel, in the approach, at long range, if large caliber guns, armor and protective decks have any excuse for costing so much, the preponderance of heavy guns of 8 inches and above (A, 18; B, 8) ought to have had a telling effect before the B ships "went off when they could."

III. The Battle off Manila.

"The issue at stake was the base in the Philippines and the whole of the western American freeboard." The destruction of the B transports "being the special object" of the A squadron, and speed being necessary to intercept them, and, at the same time, avoid an engagement with the battleships, what should be the tactics of A? The two monitors are allowed to clog the A column. We see no fast division, as in the preceding battles where such divisions were wrongly utilized or sacrificed, and now, when needed, we have two monitors to set the pace. "As fire was opened, the B ships altered course to line abreast, but only for a short while and to bring all their ships into range." The B squadron evidently knew the principles of the game. As to how the battle ended is of no consequence, because the "special object" was bungled at the start.

IV. The Cruiser Action off Manila.

This action well illustrates the limitations of war games. Throwing dice is as good a way as any to get results with night actions, because tactical manœuvres of ships at night, at sea, can alone give the experience necessary to meet emergencies of this kind. A hundred games might develop suggestions as to tactics to be pursued, but, unless tested by actual manœuvres, little can be learned. The method described is novel and ingenious, and adds an interesting realism to the game, for tabulating results is probably dull work.

V. The Operations off Kiao Chau.

Putting salt on the bird's tail has long been urged as an excellent way of catching it. Given, on a tactical war game board, two equal squadrons in column, and let the game be a series of attempts for one squadron to envelope the head or tail of the other's column, the result will almost always be a draw. The chance usually comes as an incident of other manœuvres. The important thing is to be able to tell when there is a chance. It is not out of place to again insist that the approach should be in line. There is then, for the time being, less question of one or more slow ships, and, if the center of the enemy's formation is kept on a bearing approximately at right angles from the center of your line, there is no possibility, when you get ready to go into column, of his being able to envelope its ends. Moreover, *unless he also goes into line parallel to your own,* you can cross the head or tail of his formation, if he stands on. This is because the side of a right angled triangle is shorter than the hypothenuse. I said, "if he stand on." If he understands the game, he will of course avoid the trap, for, after all, you have to catch the bird to put salt on its tail. I do not pretend to be able to furnish the formula for enveloping the ends of an enemy's column. Nor can anyone else. But the chance may come, and the thing is to tell the instant it is possible. I can furnish that rule.

After the long range promenade, illustrated in the first, second and third stage of the operations off Kiao Chau, it is just as well to adopt Mr. Jane's characterization of it as a "fiasco," and pass on. The B squadron could coal in port, and the A squadron was left to coal at sea, so I am finding fault with the A admiral for wasting valuable coal in chasing the elusive. It was his business to force an action, and on his own terms, if possible.

I am quite sure my criticisms are not captious. Mr. Jane announces that "special interest attaches to the interesting but abortive evolutions under review, because of the theory, now gaining ground so rapidly in most navies, that the battle of the future will be fought and won before range is reached, and before a gun is fired. The fighting, by this theory, will merely determine the magnitude of the victory." This is too true, but in the very opposite sense intended.

Battles will be fought and won before a gun is fired by having

admirals and captains who understand naval tactics, guns and mounts that will stand the strain, and gun captains who can shoot straight. All this must be done in time of peace, but no tactical trick manœuvre in war is going to send twenty or thirty million dollars' worth of war material to an inglorious end—unless all this is neglected. We speak of the "art of war." It is a grand art, and I stand abashed at my own presumption in posing as an expert on this occasion, but, after all, I am merely dallying with the elementary principles of tactics, which, as simple as they are, seem to be wofully misunderstood. Every day or so naval warfare is "revolutionized" in the newspapers by a dynamite gun, a high explosive shell, a torpedo, a balloon, a submarine, a ram, or a blood-curdling invention, yet all countries continue to have the temerity to go on building battleships, because good gun fire will continue to win battles as in other days, and the better trained officers and men will be on the winning side. Otherwise let us throw dice for it, and eat, drink, and be merry.

VI. The Second Action off Kiao Chau.

Again we have the game of putting salt on the bird's tail, but the trap is laid by the newly created vice admiral of the A squadron to this time *catch* the bird. The A squadron is divided into two separate divisions, this time ten miles apart. "By this means I hope to *force* a general action that otherwise seems likely to be postponed to our disadvantage," pathetically announces the commander-in-chief of the A squadron. Mr. Jane says, "it will be noted by those conversant with tactical theories, that the A tactics were of a French type." He must have in mind the popular belief in the comparative harmlessness of the Parisian duel.

All the A admiral got for his trap was that, when the B squadron came out, it promptly singed the tail (see diagram "Second Stage") of the slow A squadron. Stung into resentment, and seeing a good chance to kick the other man's dog, A bore down on the B picket boats and annihilated them. Destroyers are popularly credited with something over 20 knots' speed, but we will let it go at that. It appears that "meanwhile the four disabled ships (Fig. 3, "Third Stage") were able to close on each other." It will be noted that disabled ships can get together by this system of

tactics, but the ships in good shape were able to avoid action. The under-water tubes of the two B ships settled the fate of the two A ships, which had none, and I am glad of it, personally, for I welcome any argument that favors putting submerged tubes in our ships.

To return to the A and B squadrons, the disabled ships, two each, were able to reach each other, but mere tactics, as understood, being exhausted, strategy is to be resorted to, and night intervenes. The night action is, however, only productive of loss of sleep.

Next morning the A squadron, in column, sights the B squadron in line abreast, some 12,000 yards away. It looks as if the B squadron would force an action, but, not yet having used up all its salt, it goes into column to cross the head of the A column. We are now shown a *finesse* in tactics which to me seems entirely unconvincing, but as it brought on an action at last, I accept it cheerfully.

In the engagement of the three A's of the Maine class with three B's, all have submerged tubes, and the narrative states that "the range was kept at 3000 yards, out of the torpedo zone." The *tactical* advantage of the submerged tube consists exactly in the fact that their presence prevents their use, a paradox, but sound reasoning. I urge it as another important reason for putting them in all our ships, for "gun fire is everything" and the ram and torpedo are incidental. The umpires allow the Alabama to "get off" an above-water torpedo, but she pays for it by being sunk by two torpedoes discharged by B ships from submerged tubes, which latter is the safe and rational method of discharge. Incidentally a double turret in an A ship was umpired out of action, principally, I imagine, because misunderstood and disliked abroad. The A rear-admiral goes down in the Alabama with his unused barrel of salt, and the new A vice-admiral is umpired "killed."

A summary of the guns engaged is as follows:

	13-in.	12-in.	9.4-in.	8-in.	6-in.	5-in.
A Squadron	8	12	—	4	62	14
B Squadron	—	—	24	—	108	—

The argument is advanced that the A squadron is too weak in rapid-fire guns. It is undoubtedly a fact that the B squadron,

with its separate turret installations and separate ammunition supply for its 6-inch (5.9-inch) guns, is better able to fight both batteries at once than the A ships, whose ammunition supply is too general, nor is this the only weakness of the A method of installation of this class of guns.

VII. The Final Battle of the War.

In the engagement of the A and B flotillas of destroyers and their consorts, an interesting point is raised. False colors are used by the destroyers on both sides on different occasions to confuse the fire of the consorts. The use of false colors is, I believe, now forbidden by international law, but does it apply to this contingency? Is international law strictly binding, any way? As the A commander was afterwards relieved of his command for sinking two of his own destroyers, it looks as if the A government disapproved.

In the diagram representing the "Opening Stage of the Final Battle of the War" we see the A squadron furnishing a series of targets for the starboard battery of the B squadron without, apparently, the slightest idea that there is anything stupid in a turn of its head of column to port instead of to starboard, and without the slightest idea, also, that by approaching in line abreast they could get into action without making a mess of it. Having sacrificed the two leading and only battleships by the senseless formation for approach, the A squadron goes into line in the zone of fire, at the critical period, and masks the fire of its after turrets, permitting the B squadron to circle around its right wing and pulverize each of its ships in succession. But I imagine this is simply a stage setting to introduce the question of the ram, which loses its smokestack, gets ripped up the back, and goes down, while the submarines save the day and nation. The curtain goes down on a perfect holocaust, with two ships sinking in deadly embrace (illustrating the dangers of ramming), but the white-winged dove of peace hovers over the scene of carnage, while the clouds open and an invisible choir sings, "My country, 'tis of thee," which being the national air of three different countries, pleases everyone. The only people who are inclined to be disagreeable are the critics who cannot decide whether it is a comedy, a melodrama, or a tragedy.

The Aftermath.

Among the stage properties borrowed from A by the Portsmouth Naval War Game Society for this occasion only, and now returned with thanks, are:

Some double turrets of American design.—Not of desired pattern.

Above-water torpedo tubes.—Out of date.

Conning towers.—Dangerous for admirals.

A ram.—Ripped up the back, and out of date.

The Iowa.—A "second class" battleship.

A few battleships.—Not homogeneous and in need of refitting.

One lot of cruisers.—Out of date and of elementary design.

Some 8-inch guns.—About equal to 6-inch of recent design.

An edition of naval tactical books.—Not used.

The Panama canal.—Not finished.

Two barrels of salt.—Left over.

Three metallic caskets for admirals.—In excess of estimate.

The Anglo-American Alliance.—A needs a building programme.

There is an old saying, "Deliver me from my friends, I can look out for my enemies." The players who managed the A fleet in the game certainly developed all its weaknesses as to *matériel* and for that we ought to feel grateful. Whether or not our own admirals would have done so badly in actual war, I leave it for the Portsmouth War Game Society to judge, but I am rather skeptical as to this particular game's ever having been played just as recorded. If it was, then the A fleet has another trial coming to it, but it would be just as well if the result were not published.

THE NAVAL WAR GAME.

By Fred T. Jane.

FULL REPORT OF A "WAR" BETWEEN THE UNITED STATES AND GERMANY, NOW BEING PLAYED BY THE PORTSMOUTH (ENGLAND) NAVAL WAR-GAME SOCIETY.

[Specially and exclusively contributed to the *Scientific American*, and reprinted here by courtesy of the Editor of that Publication.]

[NOTE.—The Portsmouth Naval War-Game Society, of which Admiral Sir John Hopkins, G. C. B., is the president, is an association formed for the study of problems of future naval war, tactical, strategical, constructional and general, by means of the Jane Naval War Game. Fred T. Jane, the inventor of the game, is one of the members and first founders of the society.]

For the sake of future reference the names of the ships engaged, the speeds, coal and coal endurances assigned to them, together with a few of the general special rules are here given.

"The area of operations will extend over the whole world. So far as possible, the German strategy is to follow the lines of probable actual strategy; that is to say, it is to be usually of an offensive nature and directed against those spots which, by reason of distance from main bases, America is least able to protect cheaply. American strategy is, at the outset, to be mainly of a defensive character. But neither side is bound to adhere to any preconceived ideas outside this general idea. The fleet available for the United States is as follows:

Name.	Speed allowed, Knots.	Coal, tons.	Radius allowed at full speed. Knots.
Maine	15	2000	3000
Missouri	15	2000	3000
Ohio	15	2000	3000
*New Jersey	16½	1900	2500
*Georgia	16½	1900	2500
Alabama	13½	1450	2500
Illinois	13½	1450	2500
Wisconsin	13½	1450	2500
Kearsarge	13½	1200	2000
Kentucky	13½	1200	2000
Iowa	13½	1800	2500
Indiana	13½	1800	2500
Oregon	13½	1800	2500
Massachusetts	13½	1800	2500
Texas	12	1800	2500
Puritan	9	600	1000
Monterey	10½	600	1000
Arkansas	9	400	800
Nevada	9	400	800

Name.	Speed allowed, Knots.	Coal, tons.	Radius allowed at full speed, Knots.
Florida	9	400	800
Wyoming	9	400	800
Miantonomoh	9	300	700
Terror	9	300	700
Amphitrite	9	300	700
Monadnock	10½	300	700
*California	21	2000	2000
*Colorado	21	2000	2000
Brooklyn	18	1700	2500
New York	18	1200	2000
Olympia	18	1200	2000
Columbia	21	2400	2000
Minneapolis	21	2400	2000
Albany	19½	700	1000
New Orleans	19½	700	1000
Newark	16½	800	1500
San Francisco	16½	800	1500
Chicago	16½	900	2000
Baltimore	16½	900	2000
Philadelphia	16½	1100	2000
Raleigh	18	600	1500
Cincinnati	18	600	1500
Atlanta	12	500	1500
Boston	12	500	1500
*Chattanooga	15	700	2000
*Denver	15	700	2000
*Cleveland	15	700	2000
*Des Moines	15	700	2000
*Galveston	15	700	2000
*Tacoma	15	700	2000
Detroit	16½	450	1200
Montgomery	16½	450	1200
Marblehead	16½	450	1200
Katahdin	15	200	500
17 gunboats, etc	9	400	1000
20 destroyers	27	(see below)	
24 torpedo boats	24	(see below)	
8 submarines	9	these may stay out for 24 hours	

"Destroyers at full speed may stay out 24 hours. At 21 knots, with right to increase to full speed at 2 hours' notice, they may stay out for 48 hours. At 18 knots, with power to increase 1 knot per hour for a short time only, they may stay out for 72 hours. Their assigned speeds are always liable to be heavily reduced for weather. Torpedo boats at full speed may stay out 15 hours; at 6 knots less, with right to increase to full in one hour, they may stay out 36 hours.

*Ships thus marked are only available in the event of a very long war.

"The gunboats, should they meet any cruiser, will be held captured. Should they encounter any vessels of their own type, the action will be decided by a toss-up. The same system will be employed when individual torpedo craft meet; but should divisions encounter each other, then the battle will be fought out in the ordinary way, so that tactical evolutions will decide the issue.

"The coal supplies allotted to the various large ships are approximately correct only. The approximation is made for the sake of simplicity, and the same applies to endurance at full speed. Both sides have been equally treated in this respect. Should any ship or squadron desire to proceed at economical speed, it will be allowed. As it is difficult to obtain reliable data in all cases, a general rule will have to be followed, which, for the sake of avoiding unnecessary complication, will be as follows: Ships proceeding at 10 knots may go double the full-speed distance. As this rule applies to both sides, the approximation is sufficiently correct to cover probabilities. The nominal 10-knot radii of war ships are in practically all cases purely theoretical performances; and it may be noted that the radii allowed for this game, if small, are still probably over rather than under the actual.

"For coaling ship there will be a fixed time limit of 100 tons per hour. As cases may arise in which cruisers wish to take partial supplies only, all ships will be allowed to do this; but their bunker-cards[1] and the corresponding radii, must be duly corrected to meet the case. No ship will, however, be allowed to spend less than *six* hours coaling, even though she needs less than 600 tons. This rule is made in order that the time allowance of getting alongside and casting off collier shall be properly provided for. By this means a fair general average speed of coaling is arrived at.

"The German fleet, which will be under exactly the same general rules as the American one, is as follows:

Name.	Speed Knots.	Coal (Maximum) Tons.	Full Speed Radius. Knots.
Wittelsbach	15	1000	1500
Wettin	15	1000	1500
Zaehringen	15	1000	1500
*Mecklenburg	15	1000	1500
*Schwaben	15	1000	1500
Kaiser Friedrich	15	1000	1500
Kaiser Wilhelm	15	1000	1500
Kaiser Karl	15	1000	1500
Kaiser Barbarossa	15	1000	1500
Kaiser Wilhelm der Grosse	15	1000	1500
*"H"	16½	1000	1500
*"J"	16½	1000	1500
Brandenburg	12	800	1200
Woerth	12	800	1200

[1] The state of coal supply of each ship is carefully kept by her player.

Name.	Speed Knots.	Coal (Maximum) Tons.	Full Speed Radius. Knots.
†Kaiser Friedrich Wilhelm...	12	800	1200
Weissembourg	12	800	1200
Baden	13½	600	1000
Sachsen	13½	600	1000
Bayern	13½	600	1000
Wurttemburg	13½	600	1000
Aegir	13½	500	1500
Odin	13½	500	1500
Hagen	13½	500	1500
Hildebrand	13½	500	1500
Frithjof	13½	500	1500
Beowulf	13½	500	1500
Siegfried	13½	500	1500
Oldenburg	9	350	1000
Fuerst Bismarck	18	1100	1800
Prinz Heinrich	18	1500	2300
*Prinz Adalbert	19½	1500	1800
*Prinz Friedrich Karl.....	19½	1500	1800
Hertha	18	950	2000
Hansa	18	950	2000
Victoria Luise	18	950.	2000
Freya	18	950	2000
Vineta	18	950	2000
Kaiserin Augusta	18	900	1500
Gefion	18	950	2500
*Frauenlob	21	700	2000
*Arcona	21	700	2000
*"J"	21	700	2000
Gazelle	19½	500	1000
Nymphe	19½	500	1000
Niobe	19½	500	1000
Ariadne	21	500	800
Thetis	21	500	800
Amazone	21	500	800
Medusa	21	500	800
Irene	15	900	1400
Prinz Wilhelm	15	900	1400
Hela	19½	350	800
Meteor	18	120	700
Komet	18	120	700
20 Various	9	400	1000
30 Destroyers	27	(Coal as for U. S. boats.)	
12 Destroyers	21	" " " "	
16 Torpedo Boats	24	" " " "	
30 Torpedo Boats	18	" " " "	

* Only available after a long period.

† Presumed reconstructing.

On August 1, 1903, a state of "war imminent" is existing; and on this presumed date moves may begin, and either side may declare war or commence hostilities without it. Both sides are assumed to have brought their reserve ships as far forward as possible.

"All existing fortifications will be assumed to exist, but neither side may attack fortresses (other than minor ones) until it has secured command of the sea. All the important fortifications are assumed impregnable, and ships coming into range of them will be damaged on a scale to be decided by the umpires.

"Wireless telegraphy will be allowed a radius of 100 miles. All admirals must furnish the umpires with copies of their:

"a. General orders, signal codes, etc.

"b. Bunker records and ammunition supply records as kept by the players detailed for that purpose.

"c. Cruising formations, by day and by night.

"d. Scouting formations, etc.

"e. Recognition signals and the like, which may be needed in assessing the probable result of unexpected meetings by night.

"f. Any special orders, the observance of which might tend to turn the scale when delicate points have to be assessed. As an example, orders in view of a night attack by torpedo craft may be cited.

"g. Schemes for fire control.

"Not all of these, it may be observed, are essential to the game; but in each case they are calculated to render it more instructive, and to engender thought on important topics.

"As to the ships taking part, with a few alterations the fleets will be those at present in commission. A few new ships, that should be in commission by the middle of 1903, have replaced others, and destroyers have been added where a state of "war imminent" would seem to warrant it.

"Ships in commission will be as follows:

United States.	Germany.
Home.	*Home.*
Alabama (flag).	K. Wilhelm II. (flag).
Kearsarge.	K. Barbarossa.
Missouri.	K. Karl der Grosse.
Maine.	K. Wilhelm der Grosse.
Indiana.	Wittelsbach.
Massachusetts.	Zähringen.
Olympia.	P. Heinrich.
San Francisco.	Nymphe.
Cincinnati.	Niobe.
Detroit.	9 destroyers.
9 destroyers.	Hela.
2 torpedo-boats.	

Home. West coast.
Wisconsin (flag).
Oregon.
Philadelphia.
2 destroyers.

South Atlantic.
Iowa.
Atlanta.

Mediterranean.
Illinois (flag).
Chicago.
Albany.
1 gunboat.

Far East.
Kentucky (flag).
Brooklyn.
New York.
New Orleans.
Monterey.
Monadnock.
Newark.

Second Home.
Baden (flag).
Wurtemburg.
Hildebrand.
Hagen.
Heimdall.
Beowulf.
V. Luise.
7 destroyers.

South Atlantic.
Freya.
Vineta.

Far East.
F. Bismarck (flag).
Hertha.
Hansa.
Kaiserin Augusta.
Gazelle.
1 destroyer.

"New ships may be brought forward as the umpires will allow. It will be assumed that the ability to hurry forward new or refitting old ships is the same for both nations; a claim for a new ship by one side will, therefore, if allowed, entitle the other side to a ship or ships of about equal displacement. In view of the impossibility of ascertaining how far forward ships will be at the assumed date of the war, this rule is regarded as likely to afford the most satisfactory approximation.

"All torpedo craft not noted as in commission may, however, be mobilized as required.

"In all matters not herein specified, in all claims, and in all questions of time to repair ships, the decision will rest with the umpires. All contingencies for which the Book of Rules or 'Hints' provide will be settled as therein laid down.

"All moves are to be made by measure, and *any infringement of the rules will be regarded as an engine-room mishap*. There will be no other provision for breakdowns; so players are warned to be scrupulously correct in tactical movements."

HOW THE GAME IS PLAYED.

Strategical moves are made by each side in 6-hour runs on charts. These moves indicate the entire course of the fleet to its destination, and may be altered only (a) by contact with the enemy, or (b) receipt of contrary orders by dispatch vessel or wireless telegraphy. Ships that at any period of the cruise desire to use their own wireless telegraphic installations are required to mark a zigzag line beside their courses.

Any other ships within 100 miles are informed by the umpire that wireless is being used and made cognizant of what is telegraphed, if friends. Hostile ships are not allowed to take in the messages (ciphers being assumed).

The rival admirals having marked their courses, these are compared by the umpire at the central table, and should hostile forces approach each other within what is considered sighting distance, the ships concerned are put upon the seaboard.

The ships are accurate models, and they have to be recognized by their opponents just as they would have to be in real war. The seaboard, with which the ships are on exact scale, is divided into large squares representing 2000 yards, and small ones of 100 yards (half a cable). Each move represents one minute of time, consequently each square traversed is a three-knot difference in speed—so long as the movement is not in a diagonal direction. When ships move diagonally to the squares, a measure is employed. The turning circles of ships, of course, vary considerably; to meet this so many squares—usually two—have to be traversed from the time the helm is put over to when she has turned four points. The loss of speed entailed in turning is, of course, allowed for. For the present war, however, special cards have been issued that mark the exact circles of ships. This is necessary on account of the fact that the German ships possess a tactical advantage in this direction which is not easily reduced to the usual convention.

Each ship is maneuvered by a different player, who captains her throughout the war. The admirals, till fire is opened, are allowed to give any directions they please to their captains; after fire is opened they may transmit signals only through the umpires and at the discretion of these, and each captain has to think for himself and carry out his orders as best he can. As the umpires rarely allow anything save the simplest signals to be made in battle, the admiral who lays down his orders clearly beforehand is in much the same position as one who does so in real war.

Firing is allowed at 8000 yards, but at this distance the damage done is always slight. The method of firing is a characteristic of the game. More than one system is employed; but as a general rule targets representing the actual ship to be attacked at various ranges and positions are used. These pictures are divided into vertical sections of 25 feet each. Hits are localized by an instrument technically known as a "striker." Either every gun of and over 4-inch is struck for at varying rates of fire, or else one strike only per move is made for the whole lot of guns, and the damage varied as the range.

In the former case a 6-inch shell-fire of one minute's duration destroys one section if unarmored, and other guns do damage *pro rata*. When armor is hit, penetration depends, as in real war, on the nature of the projectile, the range and the angle of impact; all of which are calculated semi-automatically on much the same system as that used for "All the World's Fighting Ships." (Published at the *Scientific American* Office.) The damage is scored on plans of the ships identical with those in the work mentioned above—which is the textbook of the game.

When the alternative striking method is in use (as it is when the chief issue is a tactical rather than a constructional problem) the size of the target depends, not (as in the first system) on the range, but on the combined speeds of the ship firing and the ship fired at, i. e., whether they are *relatively* stationary or shifting bearings rapidly.

By this method an average accuracy ranging from 50 per cent at 1000 yards to 2 per cent at 8000 is to be obtained, supposing no misses to be made by the players. As, however, hitting is uncertain, the actual average works out very close to real battle results; and realism is secured also by the differentiation of projectiles.

This necessarily brief sketch of the way in which the game is played will afford some insight into the extreme realism that is a factor all through; the claim being that every possible condition of modern war is met. Copious books of rules scale out the chances wherever this can be done, so that a uniform system of awards is secured. These "judgments" are the mean of the opinions of naval officers specially selected in all navies. Land operations are adjusted to the same scale; but the "war" under review does not contemplate proceeding further than the securing of the command of the sea by one or other belligerent sufficiently to render invasion impossible to the one and possible to the other. No doubt, however, some small raids will have to be dealt with.

Directly war broke out, both sides put all available ships in commission. Mostly this affected the coast defence squadrons, both far removed from the scene of war, and commerce-attack cruisers, which were destined to have an early meeting.

The United States Mediterranean Squadron, which was assumed lying at the Piræus, was cabled to proceed to the Far East, and sailed for Suez the next day.

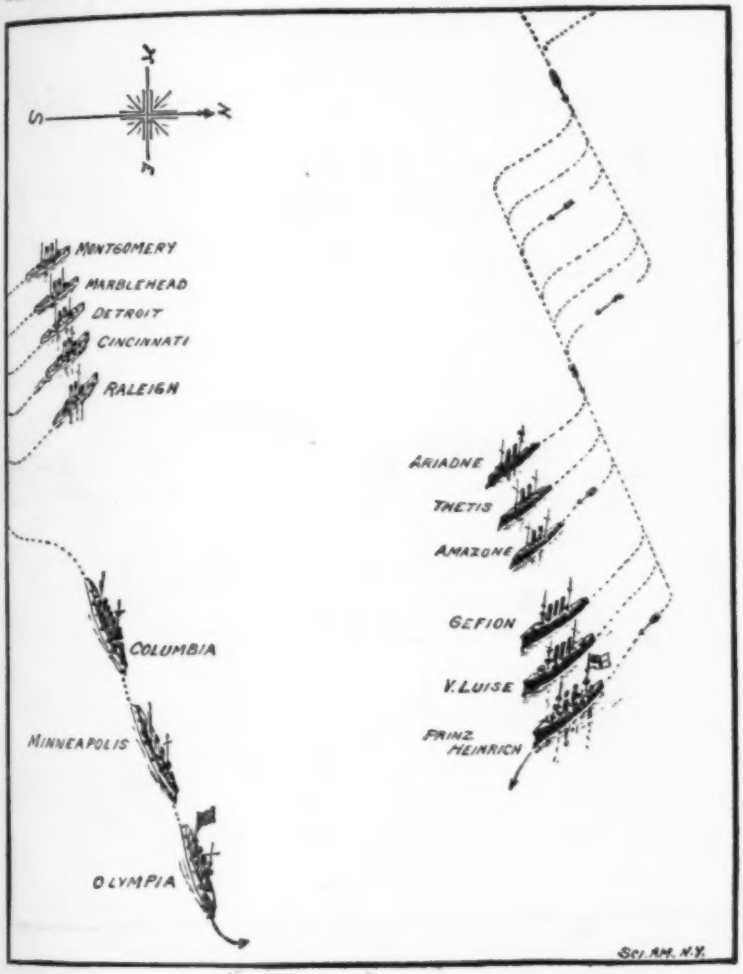
The South Atlantic Squadron proceeded to sea, with a view to trying to entice to action the Germans in those waters. The home fleet cruised up and down the coast, awaiting developments and practising battle evolutions, etc. Its cruisers, together with others newly commissioned, went along the trade route.

On the German side the first Home squadron went to Gibraltar at full speed, accompained by colliers and its destroyers. It reached Gibraltar on the 7th of August, 1903—seven days after the breaking out of the war. By this time the United States Mediterranean fleet was well down the Red Sea. This German squadron, short of several cruisers, coaled at Ceuta from its own colliers.

Both sides adopted somewhat similar dispositions for their cruisers, that is to say, there was little spreading with them. All ships maintained close touch with consorts, hunting rather for hostile cruisers than attempting action against commerce. A few vessels were chased, but the speed of these saved them, nor were the attempts to follow serious. In this way the rival squadrons had fairly clear ideas of each other's whereabouts, and a meeting was not therefore long delayed.

CRUISER ACTION IN MID-ATLANTIC—GERMAN VICTORY—CAPTURE OF THE FLAGSHIP OLYMPIA AND THE DETROIT—FOUR AMERICAN CRUISERS SUNK.

Informed by wireless telegraphy from the Columbia and the Thetis, which were the first ships to establish touch, both sides concentrated in



MID-ATLANTIC CRUISER ACTION—POSITION AT OPEN FIRE.

Mid-Atlantic. Neither was in a hurry to open the battle, preferring to wait for fresh reinforcements; and so for a whole day nothing happened save attempts to secure the most advantageous position. Toward sunset, however, both squadrons edged in toward each other, and the Germans

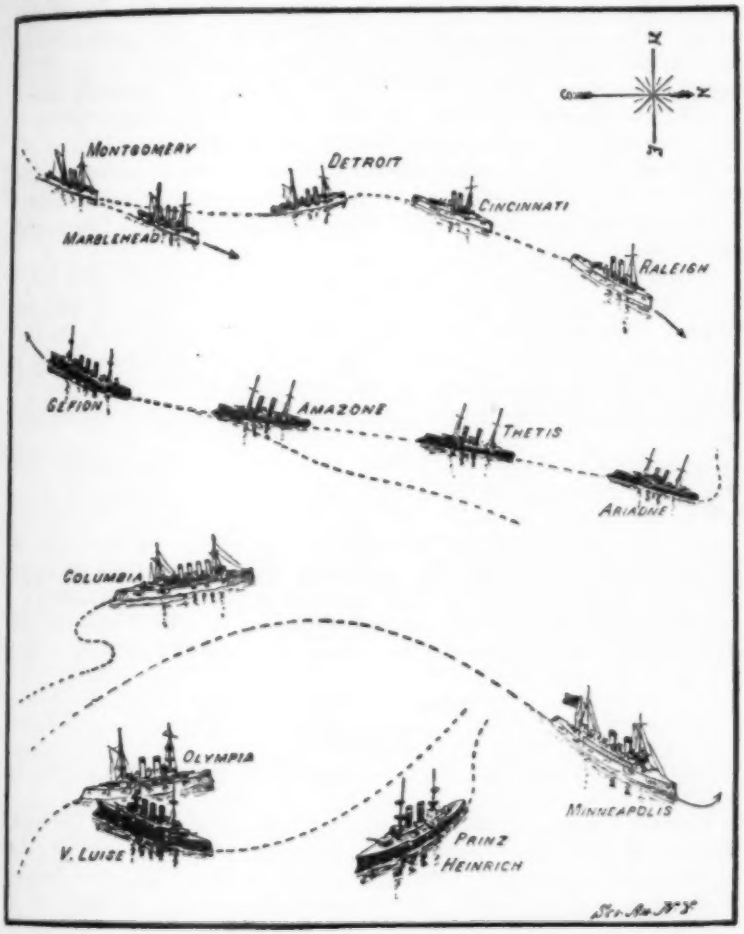
though they had fewer ships, being the heavier, took advantage of this to open the battle.

They then lay to the north of the Americans, being in the following order, the flagship to the eastward: Prince Heinrich (flag), Victoria Louise, Gefion, Amazone, Thetis, Ariadne, all steaming due south at 18

MID-ATLANTIC CRUISER ACTION—SECOND STAGE.

knots in line abreast. The Americans at that moment were in two divisions some half a mile apart. The first, steering northeast, consisted of the Olympia (flag), Columbia and Minneapolis; the second of the Raleigh (senior ship), Cincinnati, Detroit, Marblehead and Montgomery, steering northwest in line abreast, while the first division was in line ahead.

Fire was opened at 6,000 yards, but this range was speedily reduced to 3,000. All German guns were laid on the foremast of the flagship Olympia, with the result that the incident of the battle of Cape Bojeador was repeated in so far as the American admiral was concerned. At an early stage he was umpired "killed," and command passed to the captain of



MID-ATLANTIC CRUISER ACTION—THIRD STAGE.

the Minneapolis, who was second in command. American guns were, however, directed with a similar objective and with a similar result.

To this, perhaps, rather than to any direct intent was due the fact that the first divisions became involved in a *melée* well inside torpedo range. As a result of this and short range gunfire the Olympia was soon reduced to a sinking condition, the Prinz Heinrich sunk (by torpedo), the Columbia and Victoria Louise rendered unmanageable.

Only the Minneapolis rather mauled, and the Gefion, which declined close action, were in any condition to do much further work in the two first divisions.

Meanwhile the second German division, headed by the Gefion from the first, passed up between the two American divisions, torpedoing the disabled Columbia to port and the Marblehead and Montgomery to starboard. The range was small, and many of the American ships being without torpedo tubes, and none having submerged ones, all the advantage of this stage lay with their German adversaries. Perhaps, indeed, it lost them the day. Possibly the Germans would never have attempted the maneuver had the torpedoes been more equally matched.

What was left of the two American divisions went on seeking to join the Minneapolis; while the Germans, with one cruiser unmanageable, still bore northwest for a while. Here they reformed into line abreast, and returned to the fight

Meanwhile the Victoria Louise, torpedoed in the bow, made use of such headway as was left her to drift alongside the disabled American flagship Olympia. After the desultory exchange of a few shots, the Germans made an attempt to board. This attempt was a failure; but as at this time the second German division was close by, threatening to torpedo, the Olympia was compelled to strike—further fighting being massacre only.

The delay consequent on this incident, coupled with the previous delay due to the reforming of the second German division, enabled what was left of the Americans to get into line, and three ships, led by the Raleigh, opposed the German advance, bearing off to the northeast. In the encounter that ensued the Cincinnati was sunk and the advancing Germans mauled enough to make them slow down, thus permitting the two remaining Americans to escape. Giving up the chase, they returned to the prizes, scuttling the Olympia and towing the Detroit back to Kiel.

DAMAGES SUSTAINED.

German Ships.

Prinz Heinrich. (Two 9.4-inch, ten 6-inch, ten 3.4-inch.) Sunk by torpedoes.

Victoria Louise. (Two 8-inch, eight 6-inch, ten 3.4-inch.) Torpedoed in extreme bow. One casemate out of action; little damaged otherwise.

Gefion. (Ten 4-inch.) Two guns out of action. No other damage.

Amazone. (Ten 4-inch.) One funnel gone and forward guns out of action.

Thetis. (Ten 4-inch.) Badly raked on waterline. Boiler room penetrated. Scuttled by the Germans on account of the impossibility of getting her home.

Ariadne. (Ten 4-inch.) Funnels damaged; otherwise unhurt.

American Ships.

Olympia. (Four 8-inch, ten 5-inch.) Torpedoed in the extreme stern. Nearly all guns disabled. Compelled to strike. Subsequently scuttled by the Germans.

Columbia. (One 8-inch, two 6-inch, eight 4-inch.) Sunk by torpedoes.

Minneapolis. (One 8-inch, two 6-inch, eight 4-inch.) Waterline aft badly hit. Forward 6-inch out of action. Escaped.

Cincinnati. (Eleven 5-inch.) Sunk by gunfire.

Raleigh. (Eleven 5-inch.) Amidship guns all disabled. Escaped.

Marblehead. (Nine 5-inch.) Sunk by torpedo.

Montgomery. (Nine 5-inch.) Sunk by torpedo.

Detroit. (Nine 5-inch.) Battery severely damaged by gunfire. Ship rendered unmanageable. Cut off and compelled to strike.

A summary of the guns in the opposing fleets is as follows:

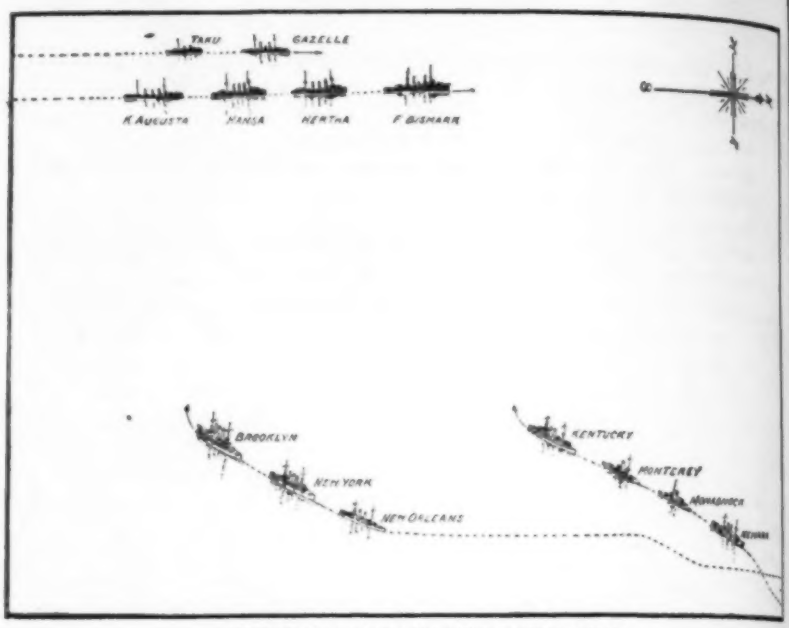
Inches	9.4	8	6	5	4	3.4
German	2	2	18	..	40	20
U. S. A.	..	6	4	59	16	..

Here, though a numerical equality is apparent, there is, when we remember that a single 6-inch is probably worth two 5-inch so far as shell effect is concerned, a great German superiority. The Columbia type in particular is very lightly gunned. The absence of submerged tubes was, however, the thing from which the Americans suffered most. The first division risked using their above-water ones, and, as luck would have it, were not hit in the torpedo rooms till the tubes had been emptied; but all these tubes were put out of action before the battle was half over.

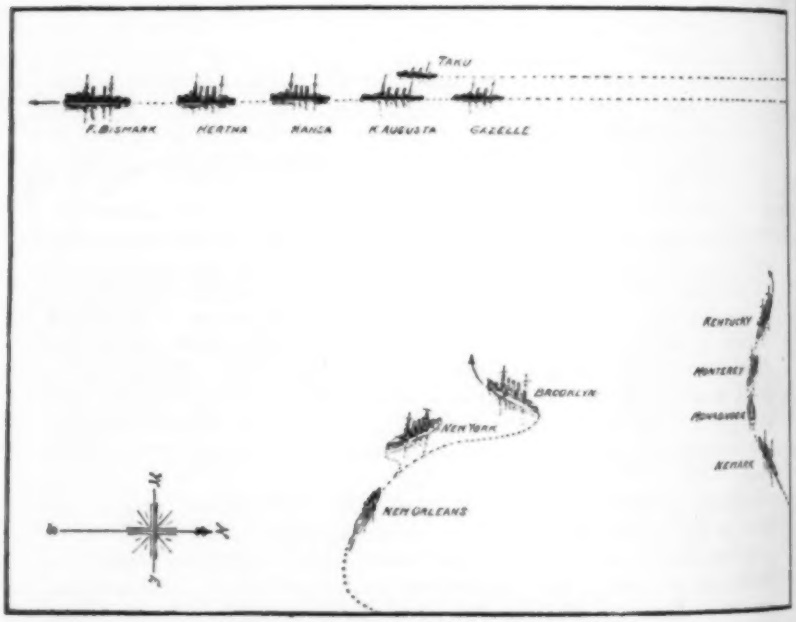
INDECISIVE ACTION IN THE FAR EAST—CAPTURE OF THE KAISERIN AUGUSTA.

For the purposes of the game, the Germans were assumed to contemplate designs on one of the outlying islands of the Philippine group. In connection with this the fleets maintained by both the United States and Germany in the Far East concentrated, the Germans being first at this off Cape Bojeador. Here, shortly after dawn, they were found by the American fleet, which steamed toward them. The Germans signaled to the Americans to keep away; this being disregarded, they opened fire. When the fleets sighted one another they were about 11,000 yards apart, and both were in two divisions line ahead. The Germans were led by the Bismarck (flag), followed by the Hertha, Hansa and Kaiserin Augusta, steering north. The Gazelle and destroyer Taku were in a second division to port—the American fleet being off the starboard bow of the Bismarck. The American starboard division, which was some six cables ahead, was formed of the Brooklyn, New York and New Orleans. The port division consisted of the Kentucky (flag), the monitors Monterey and Monadnock, and the cruiser Newark, all ships being in the order named.

Altering course eight points to starboard, the American ships were bows on to the German when these opened a heavy fire on the Kentucky and Brooklyn at 8000 yards. These were the only American ships able to reply immediately. Very poor shooting was made at so great a range, but almost the only effective hits struck the Kentucky's conning tower, "killing" the admiral who had elected to be there, and rendering the

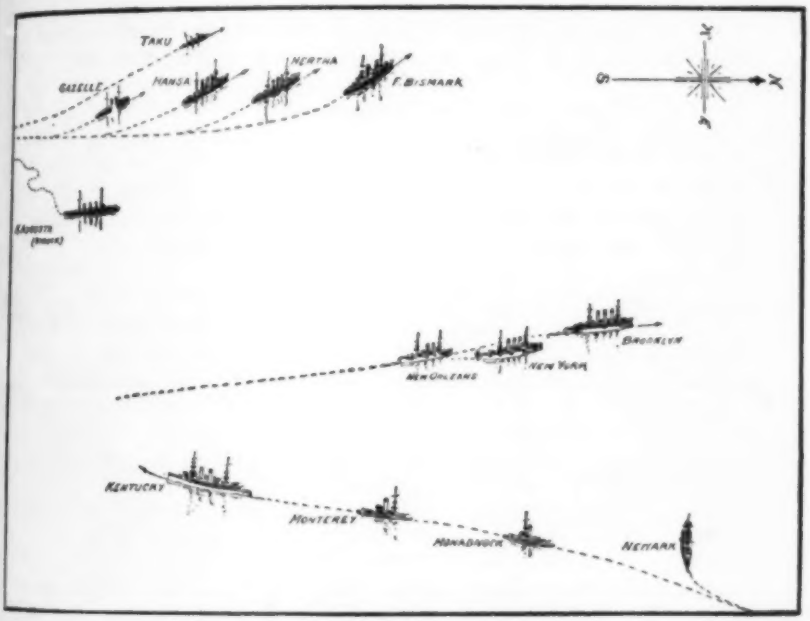


BATTLE OFF CAPE BOJEADOR—FIRST STAGE.



BATTLE OFF CAPE BOJEADOR—SECOND STAGE.

ship temporarily unmanageable. This, coupled with the fact that their speed advantage enabled the Germans to keep ahead, told against the American fleet. The Brooklyn's division, to avoid dropping out of range, was compelled to keep bow on—a position in which it was only able to deliver a limited fire; and had the Germans swung round to starboard, it is possible that the American cruisers would have been masked by the heavy division. The Germans, however, did not attempt this, either fearing to get too near the armorclads, or else preferring the alternative that they presently took.



BATTLE OFF CAPE BOJEADOR—THIRD STAGE.

Bearing away to port, so as not to allow the Kentucky to close, the Germans suddenly altered course sixteen points, returning south at top speed. The object of this maneuver was to get the Brooklyn division between them and the battleships, but the attempt was frustrated by the Americans. Still, the Newark was at this stage rarely able to fire, and the monitors only managed to do so occasionally. The Brooklyn suffered badly and the New York was heavily damaged, dropping astern. There seemed every prospect of the cruisers being overwhelmed before the slow division could come near enough to help them materially.

Recognizing this, the senior American officer ordered the cruisers to return. In doing so, they masked his battleships for two or three minutes, but the move saved the day. The Germans also altered course, no doubt expecting the battleships to do the same. Instead, these kept

straight on, and so soon as the cruisers cleared them, got their broadsides into the Germans at 4000 yards, wrecking the Kaiserin Augusta and badly damaging the already severely handled Bismarck.

With this the Germans suddenly discovered that they had had enough; and, bearing away in line abreast, they left the disabled Kaiserin Augusta to her fate. To stand by would have meant fighting the slow squadron, and this they were totally unable to risk. So they went off while they could, and this ended the action; for the Americans had not a sufficiency of fast ships to follow. But for this the Gazelle would probably have been captured also, for she was badly knocked about.

Nothing more being possible either side, the Americans having watched their opponents well toward Kiaochow, returned to Manila to refit.

DAMAGES SUSTAINED.

A detailed list of damages in this indecisive action is as follows:

American Fleet.

Kentucky. (Four 13-inch, four 8-inch, fourteen 5-inch.) Conning tower hit. Both superposed turrets jammed or otherwise disabled.

Monterey. (Two 12-inch, two 10-inch.) Not hit.

Monadnock. (Four 10-inch.) Not hit.

Brooklyn. (Eight 8-inch, twelve 5-inch.) Entire forward part wrecked, all save after turret out of action, crews cleared from all save the four after 5-inch guns. Fore funnel gone. Two hits on waterline.

New York. (Six 8-inch, twelve 4-inch.) Only the starboard 8-inch left. Out of action and probably not worth repair.

New Orleans. (Six 6-inch, four 4.7-inch.) All four amidship 47-inch cleared out.

Newark. (Twelve 6-inch.) No serious damage.

German Fleet.

Bismarck. (Four 9.4-inch, twelve 6-inch, ten 3.4-inch.) Both turrets out of action, forward group of 6-inch gone, after 6-inch gone. Bad hit on the waterline. Speed much reduced. Both masts gone.

Hertha. (Two 8-inch, eight 6-inch, ten 3.4-inch.) Forward 8-inch, two 6-inch disabled. Badly hit on waterline.

Hansa. (Two 8-inch, eight 6-inch, ten 3.4-inch.) No serious damage.

Kaiserin Augusta. (Twelve 6-inch, eight 3.4-inch.) All guns disabled. Bad hit in waterline. Engines disabled. Waterlogged. Struck to the U. S. fleet.

Gazelle. (Ten 4-inch.) Hit on waterline. Speed much reduced. Nearly all guns disabled. Conning tower blown away. Funnels both gone.

Taku. (Destroyer.) Not touched.

The plan of the action in its chief stages will serve to explain all that is not otherwise stated here; though it should be added that the Americans were not aware of how considerably damaged the German fleet was.

A summary of the opposing guns is as follows:

Inches	13	12	10	9.4	8	6	5	4.7	4	3.4
United States	4	2	6	—	18	18	30	—	12	—
Germany	—	—	—	4	4	40	—	—	10	38

The American superiority is very marked, but it has to be remembered that the Germans, by virtue of their speed advantage, were able to neutralize this on several occasions.

ACTION OFF THE SOUTH AMERICAN COAST—THE IOWA IN ACTION.

At the outbreak of the war the American force in South American waters consisted of the battleship Iowa and the old cruiser Atlanta. These were assumed to be lying at Montevideo, and they were kept here a few days pending certain slight repairs that the Atlanta was assumed to require. It may here be observed that such matters came about by a scale of chances, the idea being that this particular element in the scale of readiness or the reverse needed allowing for. It is certainly an incident that largely affects a real war, as witness the delays to Admiral Cervera's squadron in the late conflict with Spain. This particular instance is, of course, an extreme one; but in some form or other the same kind of thing marks every war.

The Atlanta, therefore, was delayed for five days at Montevideo, and the Iowa stood by her there. The ships were then further delayed by order for three more days pending information as to the movements of the first German fleet that went to Ceuta. So soon as it was definitely ascertained that this division was actually bound for the Far East via Suez, the Iowa received orders to go round the Horn and reinforce the American fleet in the Philippines.

Meanwhile the Germans in the South Atlantic had not been inactive. The second-class cruisers Vineta and Freya had been lying at Rio de Janeiro at the outbreak of hostilities. They steamed thence direct to Montevideo, but any intentions to remain off that port were negatived by the coal problem. They bore off, therefore, and after some cruising fell in with a German steamer. This vessel they took with them to Neuva Bay on the Patagonian coast, where they transshipped all her coal into their own bunkers, after which the Freya went to Bahia Blanca. At this place she in due time received news of the sailing southward of the Iowa and Atlanta. She then rejoined her consort, the Vineta, and the two put to sea looking for the Iowa.

Here they succeeded in finding, and, having found, remained observing on the horizon, intending to wait till night and then try and rush the battleship in a torpedo action—a by no means unsound plan. The only drawback to it was that the intention was fairly obvious. Not being minded to run risks of this sort, the captain of the Iowa altered course when night set in, steaming very slowly back on his tracks and then stopping altogether till dawn. The enemy, who had laid course to intercept the American division about two in the morning, failed, therefore, to sight it at all. They picked it up, however, a little after dawn, and the whole of the next day was spent in some futile maneuvers along the

fortieth parallel. The American ships tried to entice the Germans to action, first by steaming at them; then, when this proved useless, the Atlanta was dropped, in a ruse to draw the German ships to try and cut her off. They were too wary thus to be brought into action. After this the American operations were less obvious but more cunning. The "chase" of the 18-knot cruisers by ships unable to do 15 knots was renewed, with the double object of pushing the Germans further out into the Atlantic and of making them burn as much coal as possible. In this, success was achieved; for the Germans, having their own reasons for not getting too far from their temporary base, were driven to steam at full speed so as to get round and place themselves inshore of the Iowa and Atlanta. Toward night the Iowa simulated a breakdown, lying by till the darkness fell. But the Germans were not to be drawn.

With the night the Iowa made use of the time-honored subterfuge of steaming away quietly, leaving a boat with a dim light. She went straight on her proper course, and during the night saw nothing of the Germans, nor did she see them in the morning. Altering their tactics, they had steamed straight away south at full speed. At daylight they were many miles ahead. In the course of the day they fell in with and captured an American tramp steamer, and being in desperate need of coal they took her into Camarones Bay and proceeded to take her coal. They had just finished doing so when the American squadron, by the purest chance, came to the head of the bay; and an action was inevitable.

The Iowa is a second-class battleship, obsolete as battleships now go, and alone cannot be considered more than a bare match for the two cruisers. The Atlanta is a vessel of small account save in so far as her relatively heavy armament is concerned; her protection being very nearly a minus quantity. Unarmored though the German Vineta type is, the guns are armor protected, and tolerably numerous. The two ships, therefore, accepted the inevitable with good grace, and with some hopes of a successful issue.

In such a battle the tactics of the cruisers are necessarily simplicity itself. To rush in and torpedo is the obvious duty of cruisers engaging a heavier and slower force. The Freya and Vineta therefore went full speed for the American squadron, and this wisely did all in its power to keep away. The Iowa steamed off, keeping the Atlanta under cover. This was necessary; to bring the Atlanta into action merely meant losing her under the heavy rapid-fire that the Germans could bring. But the loss of the guns that the Atlanta could have brought into action was a heavy handicap to the American division, and in consequence the Iowa's fire was inferior from the first, the Germans getting in at least three to her one.

Quite early in the action, and before a single hit had been secured, the after big gun turret of the Iowa was jammed. She had only her 8-inch left to fight with, and soon one of the 8-inch turrets shared the fate of the big turret aft. Meanwhile the Germans, apparently little hurt, had got within three thousand yards.

Matters were thus when the Iowa, driven to it by the necessities of

the case, veered round so as to bring her forward guns into action. This movement, information of the intention not having been conveyed to her consort, exposed the Atlanta to the German fire, and she was almost immediately wrecked by the broadsides of the Vineta. Her return fire was ineffective save for one shell that hit fair and square on the Freya's conning tower—she having selected this ship. At the same time the Iowa's big guns were fired, and one of them took the Freya on the water-line amidships, getting into the engine-room.

This settled the Freya. A lull in the battle followed, for the disabled Atlanta drifted across the Iowa, masking her fire, and the Freya was in the way of the Vineta. This vessel took the opportunity to sheer off.

The Iowa, at last getting clear of the Atlanta, started in pursuit, not heading directly for the German, but for a point of the bay equidistant from either.

In this stage of the action it was the American vessel that suffered most from gunfire. She could, save for the 4-inch guns, bring only two 12-inch and two 8-inch to bear against one rapid-fire 8-inch and four 6-inch from the Vineta, added to such of her broadside pieces as the disabled Freya was still using. In a comparatively short time only one of the 8-inch bearing in the Iowa remained in action, and the Vineta, though badly damaged, was unsubdued. Still, her speed had sunk, and the Iowa got near enough to aim at her stern, where a lucky 8-inch shell found the steering gear at an opportune moment. Disabled, the Vineta went ashore. She continued firing, however, but the Iowa, having at last got one of her after big guns into trim, came round and gave a settling shot from that piece.

Meanwhile the Atlanta, acting without orders, had made a stealthy attempt to close with the disabled Freya. In this she was eminently unsuccessful, for the Freya abstained from firing till the Atlanta was near, then fired a torpedo with fatal effect. Subsequently she struck to the Iowa.

A summary of the guns engaged in this interesting little action is as follows:

Inches.....	12	8 R.F.	8 B.L.	6 R.F.	4	3.4
U. S. A.....	4	2 (old)	8	6 (old)	6	—
German	—	4	—	16	—	20

But of the United States guns the two old 8-inch and six 6-inch were not in the action for any length of time. Most of the battle was a case of two 12-inch, four 8-inch B. L., and two 4-inch against two 8-inch R. F., eight 6-inch and twelve 3.4-inch—a very equal match. And it may be observed that the whole thing was rather of the nature of a toss-up, the lucky shot being the predominating factor.

The damages sustained by the Iowa were heavy. Her upper works were totally wrecked, and her entire bow in the same condition. As for the Germans, the Vineta was a complete wreck, and destroyed, while the Freya, besides the loss of all steaming capacity, was tremendously knocked about. The Iowa got her as far as Bahia Blanca and there left

her, remaining herself pending news as to whether it was possible for her to return home without the certainty of being captured.

An interesting point was raised over the fact that this action was fought in neutral waters. Should it have been allowed to take place? was the question formulated. The decision was that probably it would have done so in actual war. Argentine control over Patagonian waters is of a nominal nature in many ways, and presuming that both sides meant fighting the assumption was made that the Argentine authorities would shut their eyes. It was argued that the American vessels would certainly not forego their only chance against the faster Germans for the sake of any diplomatic fictions; that the Americans would certainly have attacked on such a golden chance. To attack was necessary, whether as an act of self-preservation or for the protection of any American commerce in the South Atlantic.

OTHER MOVEMENTS.

A lull and a dearth of incident followed this action. Everything centered on the Far East and the possible danger to the American western seaboard. Eastward steamed the American Mediterranean division, astern of it a superior German fleet. The future was obvious; but in view of the second German fleet at Kiel, the American home squadron in the North Atlantic was debarred from going round the Horn to the center of trouble at the Philippines.

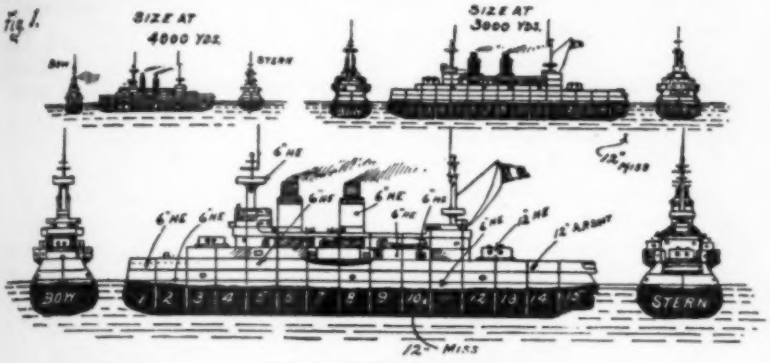
A month after the outbreak of war the American European division was at Manila. Here it coaled and revictualed, then, scouts bringing in the news of the approach of the great German fleet bound for Kiao Chau, the combined American squadrons went out for a battle against a larger fleet worn with a long voyage. The issue at stake was the base at the Philippines, and the whole of the western American freeboard. Far away, at last bound for the same waters, was the American home fleet. An Isthmian canal would have enabled it to reinforce the Far Eastern squadrons in ample time; round by the Horn this was not possible. The fleet might have done so had it been able to start directly the German move was known, but the umpires would not allow it.

The decision—and it probably expresses the thing that would actually happen in such a case—was as follows: Bearing in mind the fact that the Germans have at Kiel a second fleet consisting of Brandenburgs and some of the Wittelsbach type, and that this fleet—did the United States North Atlantic squadron withdraw—would be in a position to cross the Atlantic and destroy the American eastern coast, it is considered that American public opinion would prevent the sending of the home fleet to the Philippines, at any rate till such time as a force of monitors could be collected and put to patrol the coasts of the eastern seaboard. And it is considered that, one way and another, this fleet would not be able to depart further south than West Indian latitudes till about three weeks after the arrival of the first German fleet at Ceuta. This decision was protested against, but the umpires held their ground, and further pointed out that the mere decision to send the North American fleet to the Philip-

pines could not be put into effect within a week or so, and that this delay, apart from any other, would prevent this fleet from arriving on the scene in time to participate in the coming Armageddon off the Philippines.

HOW HITS ARE DETERMINED.

In response to numerous queries from our readers, we give here a fully detailed account with illustrations of the methods by which shooting is simulated in the naval war game.



SIZE AT 2000 YARDS.

CHARLEMAGNE, ST. LOUIS AND GAULOIS.

SPECIMEN OF A TARGET.

The three groups of figures (bow, broadside and stern) represent the relative size of the ships, as seen through the telescopic sights, at 4000, 3000 and 2000 yards. It will be readily seen that the chances of hitting the particular point (turret, gun, conning tower, etc.) aimed at are increased at the closer ranges. The player strikes with the needle-point striker (as explained in the article) at a paper target similar to this, selecting the diagram corresponding to the range of the ship that he is attacking.

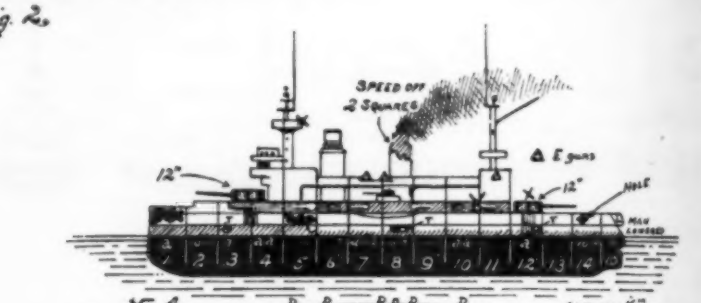
1. From *open fire* no admiral may speak about the game. If he does he will be counted "dead," and command pass to the next in seniority at once. The same applies if the admiral shoots for, or in any way assists the shooting of, another ship. Each captain is to take his own target (all are marked). Any captain communicating information to the admiral (save by signal) will lose from 3 kts. speed to a complete breakdown at umpire's discretion. Signals can be made with buoys (4 sorts allow 32 varieties). Others must go through umpire, written on paper. Any player hoisting a signal on a shot-away mast will be treated as "communicating information," and punished as above.

2. As games are often unduly prolonged by players questioning the umpire's decision, notice is hereby given that, as umpiring is on a uniform system carefully worked out, *this will not be allowed. Any player doing so will have his steering gear permanently disabled.* It is of the utmost importance that the play should be as rapid as possible. (3 knots will be lost for asking the umpire irrelevant questions.)

3. Q. F. guns will be fired first, then big. Players who cannot fire in the allotted time will not be allowed to shoot. The Red side are always to send up targets first. Only one target per ship is allowed. Nothing will be scored when the target is torn. The umpire gives the range, deducting for speed, etc.

4. Each player is to keep his scorer in his pocket ready to hand to the umpire when called for. If he shows it to anyone it will be treated as "communicating information." Everyone who fires at a ship and *makes a hit worth scoring* (i. e., affecting speed, guns, torpedoes, or steering) is to call out the name of the ship hit. The player of that ship is at once to have his scorer ready for the umpire to mark. The umpire will notify damages that could be seen—a bad funnel hit with brown paper—a bad hit in battery by white paper—placed over the ship. A ship whose buoys are taken away may not steer. All temporary damages last till umpire removes indications. Nothing may be done contrary to what could or would be done in war.

Fig. 2.



THE "SCORER," ON WHICH THE HITS MADE ON THE "TARGET" (FIG. 1) ARE NOTED DOWN AS THE FIGHT PROCEEDS.

EXPLANATIONS OF NUMBERS AND LETTERS ON DIAGRAM.

Guns.

4 A = 12-inch.
10 D = 5.5-inch rapid fire.
8 E = 4-inch rapid fire.

Torpedo Tubes.

4 submerged in sections 3 and 12.
6 above water in sections 3, 8 and 12.

Armor.

Belt *a a a* to *a* = 30 to 8 inches of iron (equivalent of).
Protection to engines, *a a a a* = 36 inches of iron.
Lower deck belt, *c* = 6 inches of iron.
Battery *d* = 9 inches of iron.
Turrets *a a a* = 30 inches of iron.
Hoists *a a a* = 30 inches of iron.

The first diagram is a "target" reproduced the actual size. It is one of the French Charlemagne type, this vessel being specially selected as

one of the best to illustrate the system. For the sake of argument we will assume her to have been fired at by the U. S. S. Maine with a broadside of four 12-inch and eight 6-inch R. F. guns.

Firing is done on pictorial targets like the one we illustrate. It is done with an instrument called a "striker," which is in essence a fine needle inserted nearly (but not quite) in the center of a thin, flat board approximately of the same size as the target shown. In every striker the position of the needle point varies slightly. Each striker is fitted with a handle 12½ inches long—12½ inches being the scale for 1000 yards in the game.

The player holds the striker at the end of the handle much as a hammer might be held. He notes the needle point, then, fixing his eye on the spot desired to be hit, endeavors to strike it. This in some 75 per cent of cases can be done by anyone *provided* he is absolutely cool. The slightest tension or excitement, such as an extreme desire to hit may cause, probably produces a miss. Thus not only the chance element—so essential to any realistic simulation of naval war—is provided, but also "moral effect." Experience indicates as an invariable fact that directly a player's ship is badly knocked about, directly it is of the most urgent importance to him to secure hits to avoid defeat, so in strict ratio does his accuracy decline. It is a curious fact, too, that the worst shooting is often made on the big "2000 yards" target. Ordinary excitement is thus made an asset of value in simulating actual war.

Countless alternative methods of imitating gun fire have been suggested and tried—indeed, the tyro almost invariably suggests "improvements" in this direction. As invariably, however—once he has warmed to the game—does he refuse to accept any of these alternatives. Once he principle is understood, it is realized that nothing else gives the mixed skill and chance factor so well as the apparently rudimentary device; nor can any system of dice or points differentiate so easily between actual ships. By this actual ship system, a choice of projectile that will destroy the Maine may leave the Charlemagne little hurt, and similarly shell fire enough to destroy the Charlemagne may affect the Maine very little.

Holding the striker at least a foot away from the target lying on the table before him, the player strikes for such big guns as he may have available. He strikes at the target suitable for the range and position, gaged from the positions of the models during the one minute move preceding. These big guns he may strike for fairly leisurely—he is allowed, for instance, to see where the first hit went before firing the second—as a rule. His gun is assumed loaded with common shell; if he desires to use any other projectile, he must have notified the umpire that he has loaded with it the move before. His big guns fire on alternate moves only, and in the case of some guns at far longer intervals.

Against each hit made by the needle point he marks the projectile and its nature.

He then fires his R. F. guns, which—unless anything else is claimed beforehand—are assumed to discharge high explosive shell.

These R. F. guns he strikes for in rapid succession, one strike for each 6 or 8-inch gun. A couple of 5-inch or 4.7-inch counts as one 6-inch, and

one strike is allowed for the pair. Lesser guns are usually not struck for; if they are they are commuted on the scale that four 3-inch equal one 6-inch, assuming both to fire for one minute.

The target is then (without further inspection by the player as a rule) sent to the umpire. In the case illustrated he demanded the "scorer" for the Charlemagne (Fig. 2). On this scorer, which is a plan of the ship divided into vertical sections of 25 feet each, the umpire scores the damage by scale.

One minute's 6-inch fire doing 1 section per gun.
One minute's 8-inch R. F. fire doing 1½ section per gun.
One minute's 9.2-inch R. F. fire doing 2 sections per gun.
One minute's 12-inch R. F. fire doing 4 sections per gun.

A 13-inch doing 6 and a 16-inch 10 sections horizontally, supposing the spot hit to be unarmored. This is common shell fire. With A. P. shell about half the effect would have been secured, with A. P. shot a quarter.

Where armor is hit the question of penetration enters. Armor is notated as follows:

aaaa = 36	inches	iron,	or	its equivalent.
aaa = 30	"	"	"	
aa = 24	"	"	"	
a = 18	"	"	"	
b = 15	"	"	"	
c = 12	"	"	"	
d = 9	"	"	"	
e = 6	"	"	"	
f = 3 or 4	"	"	"	

Penetrations are scaled from this according to the actual penetrations of the guns engaged, with the proper reduction for impact at an angle. When a ship is at an angle (and this the models indicate) hits only count on the half or other fraction of the target that would be exposed. For many hits rules are impossible. In such cases common sense is used by the umpire, who always has to bear probabilities of actual war in mind.

In the illustrations given it will be noted that one 12-inch (A. P. shot) hit an unarmored spot. Obviously it would pass through and do no harm. The second—a 12-inch high explosive shell—hit the after turret fair and square. The verdict was that both guns would be disabled. They were therefore crossed out in the "scorer," and the player of that ship might use them no more. The other two big guns missed.

Let us now take the 6-inch. The first hit section 1 main deck. It destroyed a section there. The next hit the waterline, section 2. It could not penetrate, so did no harm. The third chipped the fighting top. The fourth burst underneath the guns in section 5. Such a burst might do little harm or a great deal—it is pure chance which. The umpire threw a dice to decide. The result was provided for:

6. Both guns out for good.
5. Both guns out for five moves.
4. Both guns out for two moves.
3. One gun out for five moves.
2. One gun out for two moves.
1. No harm to guns.

A "six" was secured, so both guns (port and starboard) were crossed out and not allowed to fire again.

The fifth shell hit the battery armor, and, failing to penetrate, did no harm (section 9).

The sixth entered the gunport in section 10. Here it would certainly wreck the gun. It might wreck the gun on the other side, but the battery screen prevented it in this case.

The seventh shell, hitting thick armor in section 11, waterline, did no harm. Shell eight was a fair and square funnel hit, again one that might or might not blow out the fires. A scale of dice decided the result.

A "six" entailed loss of speed by blowing out of all fires served by this uptake, lesser numbers a lesser loss. A "five" was secured, and two squares speed (equal to six knots) lost.

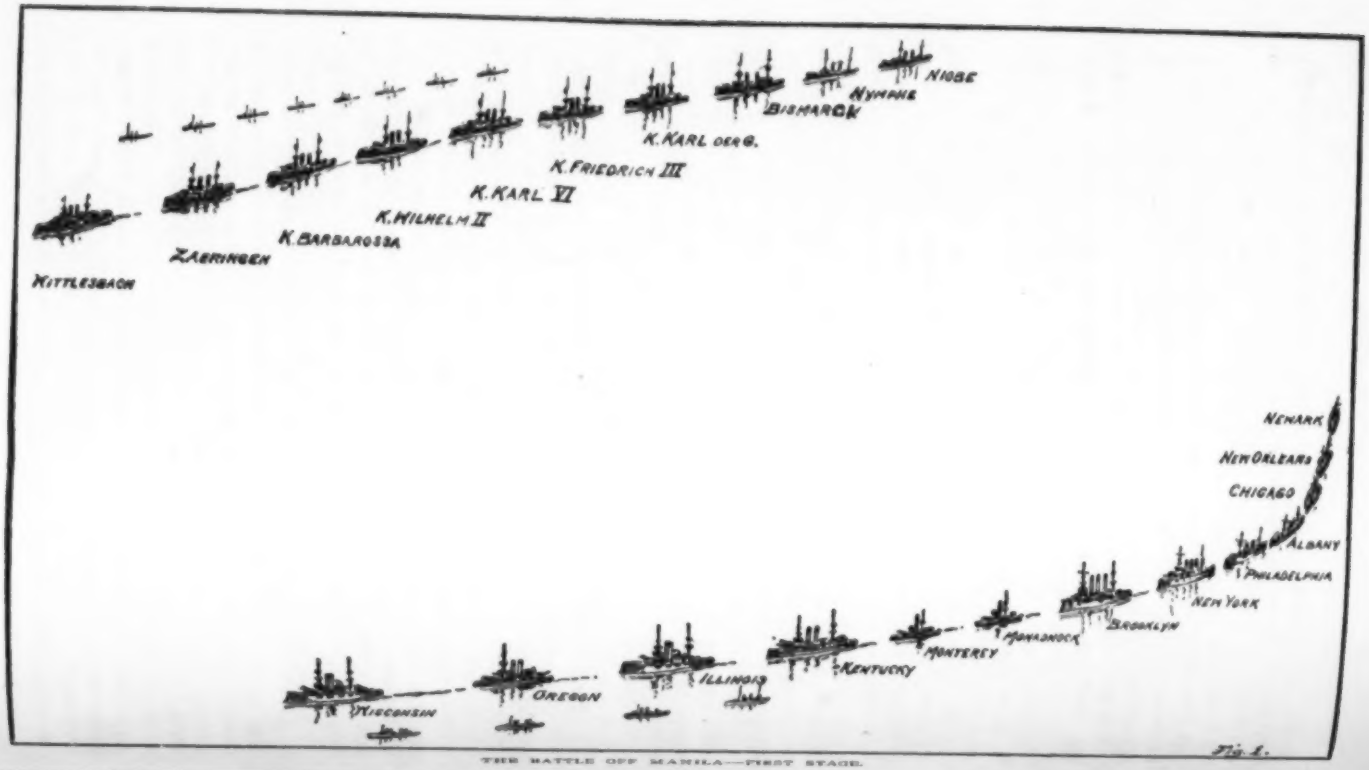
For the rest it will be noted that record is kept on the scorer of the R. F. guns bearing in any direction and a tally kept accordingly.

Apart from the interest that this simulation of shooting produces, it may be observed that the system teaches the guns and armor of warships in a singularly easy way. The great value of the game lies in this direction; and it is a remarkable thing that the British Admiralty, which some two years ago adopted the game for use at Greenwich Naval College, took the alternative system of points in preference to the proper shooting method, using the game only for tactical lessons, which pieces of wood could have simulated equally well. In several other instances in other countries the official mind has proceeded along the same lines. Where, however, the game has been adopted for military purposes, for coast artillery training, the orthodox shooting system that we have described is used, and the result has been that the military when playing against naval officers usually defeat them in any conflict demanding knowledge of the weak points of warships. This it is that has in England given rise to the latest theory that tactics unless very brilliant indeed will, in these days, be second to scientific selection of projectiles suitable for the ship to be attacked. And, as any of our readers may test for themselves in the illustrations given, "discriminating fire" is no more possible at war game than in actual fact. The ship as a whole is the target. The Charlemagne we give is an instance of bad selection. To fire armor-piercing projectiles at such a ship is an error, for the area to be so damaged is small. The area to be destroyed by shell is, however, great.

CRUSHING DEFEAT OF THE AMERICAN FLEET OFF MANILA.

The German fleet, its transports and colliers well astern protected by destroyers, was found by the American scouts. These it made no attempt to drive back or evade as it shaped course for Manila. On the seventh parallel it altered course, and, passing through the Balabac Straits, came to anchor in the Bay of Islands in Palawai of the Philippine group. Here it coaled from its colliers as before, and spent four days in minor repairs.

The American fleet meanwhile lay at Manila, whither it had returned after a short cruise. It was compelled to keep the monitors with it, and these restricted its operations to a narrow sphere. In addition the Amer-



THE BATTLE OFF MANILA—FIRST STAGE.

Fig. 1.

ican fleet had received fresh orders to the effect that it was not to fight unless absolutely necessary till the North Atlantic Squadron should be at hand.

Such orders were easy to issue, but when the German fleet, having weighed, proceeded to Pt. Sampaloc, near Manila, and there proceeded to land troops under the guns of the fleet, a fight became unavoidable. The American fleet, therefore, steamed out, not hoping for victory, but bent upon doing the maximum of damage before it should be annihilated—the destruction of the German transports being its special object. The two fleets were thus constituted:

BATTLESHIPS.

UNITED STATES.	GERMAN.
Wisconsin (flag).	Wittelsbach (flag).
Oregon.	Zaehringen (flag).
Illinois (flag).	Kaiser Barbarossa.
Kentucky (flag).	Kaiser Wilhelm II.
	Kaiser Karl VI.
	Kaiser Friedrich III.
	Kaiser Karl der Grosse.

MONITORS.

Monterey.
Monadnock.

ARMORED CRUISERS.

Brooklyn.	
New York.	Bismarck.

CRUISERS.

Philadelphia.	Nymphe.
Albany.	Niobe.
Chicago.	8 destroyers.
New Orleans.	
Newark.	
4 destroyers.	

Both fleets were formed in this order in single line ahead, and the Germans standing away to the westward seemed to leave open the transports. The object of this attempt to get the American vessels inshore of themselves was fairly obvious, but as the Germans had the speed gage there was no way of preventing such a thing in the long run. The American admiral, the transports being his objective, made straight for them till the ships came within range. As they did so, both sides moved up destroyers, which in each fleet now took station on the off side of the battleships, the Germans to starboard, the Americans to port.

The Germans, as fire was opened, altered course to line abreast, but only for a short while and to bring all their ships into range. They were quickly in line ahead again, the entire fleet concentrating on the Illinois, which ship, out of control, drifted out of the line and across the line of fire of some American vessels.

So soon as this happened she was let alone and fire bestowed upon the

Wisconsin; thence it passed to the Kentucky and Oregon, in each case being steady till a drifting wreck was the result.

All this while the German fleet, steaming its hardest, was slowly decreasing the range and nearing the head of the American line, which, compelled to do so to avoid being headed off, was continually bending to port and getting more and more in disorder. Soon it was a sagged line, the monitors nearly at the head of it, the other battleships at irregular intervals, and the cruisers in a bunch astern vainly endeavoring to get clear of the disabled Illinois.

The American fleet had not been idle in its relatively feeble reply. Selecting the weaker, it inflicted enormous damage on the Bismarck (only lately repaired after the battle that opened the war), and both the Kaiser Friedrich III and Kaiser Wilhelm II were badly hit and had to drop astern.

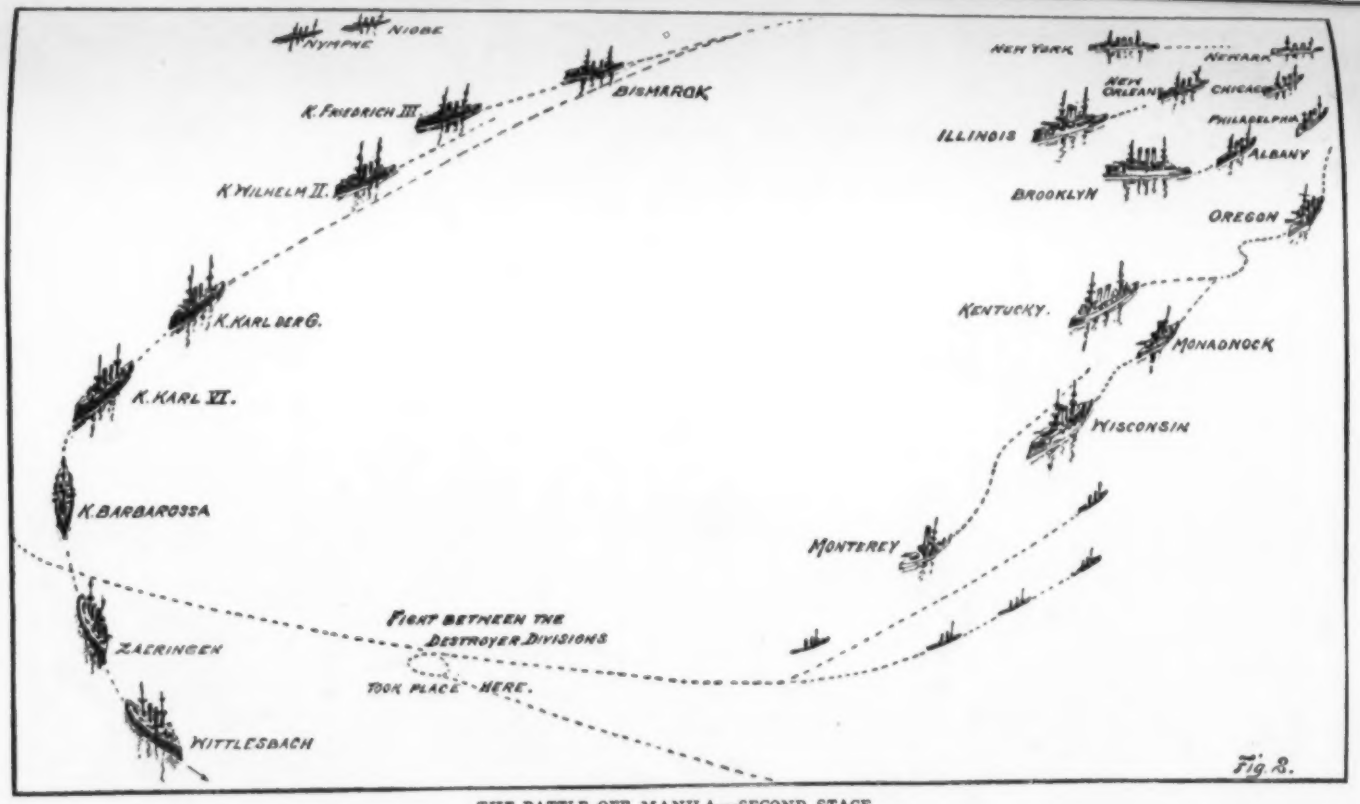
These ships, as dropped, concentrated on the cruisers and disabled battleships so soon as their consorts cleared them. The rest meanwhile were now almost across the bows of the American line, concentrating a renewed fire on the Wisconsin, now second in the line astern of the Monterey and ahead of the Monadnock. With this tremendous fire there came a rush of the eight German destroyers, from behind the battleships, now less than three thousand yards distant. The four American boats steamed out to meet them, but the fire on the head of the American line was so fierce that one was hit and sunk at once. Then, as the Germans' fire shifted to the ships farther down the American line, to avoid hitting their own destroyers, a battle of small craft ensued. Three German destroyers were rammed or sunk, the three remaining Americans met a like fate. The other German boats came on.

To meet them there were first of all the Monterey, which carries practically nothing against torpedo craft. She was bows on. Astern of her the Wisconsin was terribly mauled, and also end on, a position in which the minimum number of guns could bear. She was also, owing to the concentrated fire that had played on her, unable to steer, consequently unable to bear her broadside.

Astern again was the Monadnock, the Kentucky nearly abreast and masked by her. The Oregon was a long way astern of these two. Then came the Illinois and the cruisers, which opened out as well as they were able, with a view to firing on the oncoming destroyers. As the whole German fleet was firing into the midst of these vessels, they were able to contribute very little to check the boats. The latter had chosen the ideal moment to attack, and they secured the Monterey, Wisconsin, Monadnock, and Kentucky, with the loss of only one more boat. A second was sunk by cruiser fire a little later; the other two escaped by getting under the lee of the sinking Wisconsin.

All the torpedoes of the boats were used in this attack, but the sight of the boats sufficed to keep back the Oregon. She turned away and tried to form some kind of line with the cruisers and the Illinois, or rather such of them as were left in fighting condition.

From here onward the fight had no tactical interest; it was simply a massacre of ships retreating slowly to Manila, fighting to carry out the



THE BATTLE OFF MANILA—SECOND STAGE.

order to do all possible damage before going under. It did not last long; every American gun was matched against half a dozen German ones at this stage. It was also cut short by the return of the destroyers. These, having renewed their torpedoes, came in and gave a *coup de grace* to the two battleships—the cruisers save the Albany and Brooklyn were already accounted for by gunfire. These two vessels, the former little damaged, escaped into Manila—the sole remnants of the United States fleet. No pursuit was attempted. German ammunition was—it turned out—exhausted or nearly so.

The Chicago was sunk; the New York, trying to crawl away, was fouled by the disabled Philadelphia, and captured, as also were the Newark and New Orleans. This last, which had been little fired at, was taken; the other ships were so injured that, their crews having been removed, they were scuttled by the victors.

A list of the guns engaged is as follows:

UNITED STATES FLEET.

	13-in.	12-in.	10-in.	8-in.	6-in.	4.7-in. or 5-in.	4-in.
Wisconsin	4				14		
Illinois	4				14		
Oregon	4			8	4		
Kentucky	4			4		14	
Monterey		2	2				
Monadnock			4				2
Brooklyn				8		12	
New York				6			12
Philadelphia					12		
Albany					6	4	
New Orleans					6	4	
Chicago				4		14	
Newark					12		
	16	2	6	30	68	48	14

GERMAN FLEET.

	9.4-in.	6-in.	4-in.	3.4-in.
Wittelsbach	4	18		12
Zaehringen	4	18		12
Kaiser Barbarossa	4	18		12
Kaiser Wilhelm II.	4	18		12
Kaiser Karl VI.	4	18		12
Kaiser Friedrich III.	4	18		12
Kaiser Karl der Grosse	4	18		12
Fürst Bismarck*	2	6		4
Nymphe			10	
Niobe			10	
	30	132	20	88

*** The Bismarck arrived from Kiao Chau on the same day that the Germans arrived off Manila from the south. The slight delay was made in order to effect this junction at the appointed day. The Hertha and Hansa, which should have come also, did not arrive till after the battle. The reduced armament of the Bismarck is due to her previous battle.**

Summarized, the guns stand thus:

	13-in.	12-in.	10-in.	9.4-in.	8-in.	6-in.	4.7-in or 5-in.	4-in.	3.4-in.
United States	16	2	6	0	30	68	50	14	0
German	0	0	0	30	0	132	0	20	88

Here the German superiority in 6-inch guns is very marked, and it was the 6-inch and smaller pieces that settled the day. In the matter of big guns the disparity is small: the lesser caliber of the German pieces being more than made up for by the slower rate of fire of the heavy American guns. For the rest, we may say roughly that an 8-inch and a 6-inch come to much the same thing, because the latter is so much more rapid. Indeed, the United States 8-inch being mostly old guns might be reckoned inferior. Similarly, for any given time one 6-inch is roughly equal to two 5-inch (or 4.7-inch) and three 4-inch, which last are about on a par with the 3.4. Taking this approximation, we find that the armaments in minor pieces of 6-inch caliber or its equivalent were:

German	168
United States	*say* 128
German advantage	40

In addition, of the German guns the 132 6-inch were all behind 6-inch armor. Of the 98 8 or 6-inch guns in the United States fleet, only 54 were protected by any armor save shields. Fourteen 5-inch in the Kentucky were so protected, but that only adds the equivalent of seven 6-inch to the United States total. Had the fight, therefore, been one of mere gunfire, the result could hardly have been different.

There was, however, the tactical advantage of the Germans, which was great. Their ships were homogeneous or nearly so, and they had the speed gage. The monitors clogged the American line and reduced its speed enormously. In addition, being inshore, they were very hampered, and unable to neutralize the German speed by turning to port as much as they might have in a seaway. The odds, in fine, were against the American fleet in every way.

AFTER THE BATTLE OF MANILA.

After the victory of Manila the German fleet proceeded to blockade the bay, and a claim was put in for the capture of the American base. This the umpires disallowed.

The entire German military force was then landed, and a number of shore operations followed. To follow these in detail would be tedious, and it suffices to say that the net result was a falling back of the American army upon Cavite, which the Germans invested.

The working of the game about here was not eminently satisfactory to all those engaged in it, for reasons to be found below. The umpires deducted ten per cent of the German force for "sickness due to the effect of climate on troops worn out by a long sea voyage." This decision was hotly contested by the German players, as also was a second decision in

which the umpires refused to allow the Germans any information as to the whereabouts of the American North Atlantic squadron, last heard of as steaming south off Rio de Janeiro. The reasons for this refusal were as follows:

The American players put in that the North Atlantic squadron after passing Rio Janeiro, spread out, so that if sighted by any merchant vessels, one American warship and not an American fleet would be reported. In addition to this the Maine and Missouri were ordered to steam back toward Key West until they had been sighted thus by merchant vessels. This accomplished, they were to return again and pick up the rest of the squadron off the Horn.

The whole American situation was at this time precarious, for the second Kiel fleet was displaying considerable activity. Leaving Kiel, it steamed north, a formidable enough squadron consisting of the Wettin, Mecklenburg (lacking her heavy guns), Brandenburg, Woerth, Weissemburg, Kurfurst Friedrich Wilhelm, Baden, Sachsen, Würtemburg, Bayern, Aegir, Odin, Heimdall, Hildebrand, Hagen, the new armored cruiser Prinz Adalbert, the old cruisers, Irene and Prinzess Wilhelm, with sixteen destroyers and six 25-knot torpedo boats. With it were several colliers. Ostensibly this fleet, of practically every available German ship remaining, was bound for the North American coast. The whole move constituted a very clever ruse, in the following fashion:

A trifling calculation showed that by far the greater number of these ships carried too little coal to cross the Atlantic, so the United States North Atlantic squadron proceeded toward the Philippines without regard to the new menace. Presently the (from the U. S. standpoint) expected happened, and the second Kiel fleet was heard of as having gone into various bays on the Norwegian coast. It was then ascertained that many ships were going back singly and more or less secrety to Kiel. The American side chuckled and went on chuckling till they heard that the Wettin, Mecklenburg, Brandenburg, Woerth, Weissemburg, Kurfurst Friedrich Wilhelm, Prinz Adalbert, Irene, and Prinzess Wilhelm, accompanied by many colliers and with from twelve to fourteen destroyers in tow, were in mid-Atlantic. The ruse, in fine, was eminently successful.

We may here leave the second Kiel fleet for a time and return to events in the Pacific.

Off Manila, presently isolated and unable to cable, the Germans maintained a desultory blockade. Three of the Kaiser class (Kaiser Friedrich III, Wilhelm II, and Wilhelm der Grosse) had gone to Kiao Chau to refit; the Bismarck also had gone thither for the same purpose.

All this while the U. S. S. Ohio had been completing for sea at San Francisco. When ready she ran south, intending to meet the North Atlantic squadron at Cape Horn. The Germans, having received information of her departure, dispatched the Wittelsbach and Zaehringen to intercept her.

This reduced the blockaders to two ships of the Kaiser class and the Hertha and Hansa. Learning this, the Albany ran the blockade and got away south without injury. The Hertha and Hansa chased her a little way, but were soon left behind.

The next night the Brooklyn essayed the same thing, but blundering into one of the battleships, was sunk by a short range fire.

The methods by which this blockade running was worked may be of interest. The blockaders were made to furnish a chart and full notes of their positions for the whole period. All movements and positions that could be observed from the shore were communicated to the Americans, and the course of any blockade runner compared with the positions of the blockaders at any given time. If this brought hostile ships within sighting distance, subsequent incidents were worked out by whatever orders had been issued by either side against such a contingency.

On the night that the Albany ran out, the battleships were some ten miles out, due west, the Hertha and Hansa being well south, the latter close inshore. Passing between these two ships, the Albany was sighted by the Hertha, which fired rockets. Bearing inshore to avoid the Hertha, the Albany came within 2500 yards of the Hansa, and shots were exchanged. These were ineffectual, and her high speed enabled the Albany to escape.

The Brooklyn the next night took an identical course, but when bending inshore from the Hertha, sighted the Hansa without being seen. (These questions of sighting, being pure chance, were settled by dice throws.)

Seeing the Hansa, she bore round due west. The player who acted as captain of the Hertha also sighted the Hansa, and opened fire on her in mistake for the Brooklyn. She then got out searchlights, and discovering her mistake, fired signal rockets. The battleships, acting on the prearranged orders, steamed in toward the lights, and it was umpired that, silhouetted against these lights, the Brooklyn would be seen before seeing the Germans.

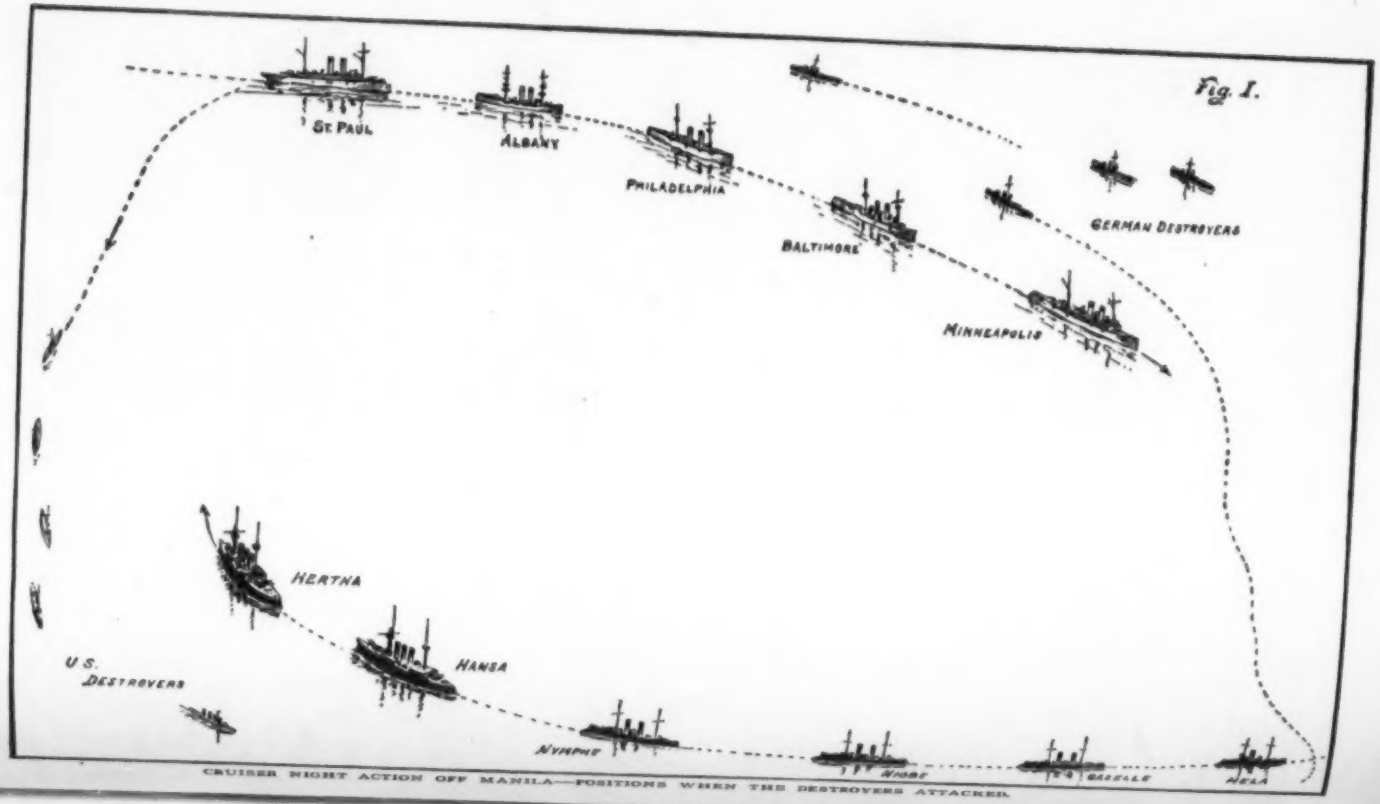
One battleship opened on the American cruiser at once, the other bore round southwest, and this ship—the Kaiser Barbarossa—it was that sank the Brooklyn.

The Albany, once clear, went on south and fell in with the U. S. North Atlantic squadron without incident. This fleet, lacking scouts, found her extremely useful.

DESPERATE CRUISER ACTION OFF MANILA.

To take the events foreshadowed in the previous article in order, the first incident to deal with is the attempt of the two Wittelsbachs to intercept the Ohio. This attempt was a complete fiasco, the Germans never getting within a couple of hundred miles of their would-be quarry. Like the Duke of York in the song, who marched ten thousand men up a hill and then marched them down again, the two battleships got out a certain distance, waited, found coal getting short, and then came back again.

They had barely returned to the Philippines when the approach of the North Atlantic squadron was announced. The invading army made an attempt to carry the American base by assault, but this was umpired a failure. Then, having lost over 30 per cent of their original force, they were hastily re-embarked under the guns of the fleet, and the entire force retreated to Kiao Chau, leaving a couple of cruisers to mislead the American scouts.



CRUISER NIGHT ACTION OFF MANILA—POSITIONS WHEN THE DESTROYERS ATTACKED.

As a result of this the American fleet delayed some while, but finally the cruisers running into Manila found the place still in American hands. Coaling hastily they put to sea again, and in the middle of the night fell in with some German vessels. These, turning on searchlights, opened fire and so secured an initial advantage. Immediately after they switched off and neither side used lights afterward.

DESPERATE CRUISER ACTION OFF MANILA.

The rival forces, though neither had any clear idea of the other's strength, were as follows:

GERMAN.	UNITED STATES.
Hertha.	Minneapolis.
Hansa.	Albany.
Gazelle.	Baltimore.
Nymphe.	Liner St. Paul.
Niobe.	Philadelphia.
Hela.	5 destroyers.
4 destroyers.	

When fire was opened the squadrons were each in line ahead. The destroyers disposed ahead in either case were recalled by both sides at once, and each senior captain was struck with the same idea. In brief, this idea was to drop the destroyers astern, and circle the big ships so that the enemy would blunder onto the waiting destroyers in the darkness.

Everything happened just as each had expected. The German ships circled and came into the American destroyers, which torpedoed every one of them at near range. At the same time the American ships blundered into the German boats to meet their fate.

The whole battle was over in less than five minutes. The big ships being disposed of, the destroyers fought each other, friend occasionally engaging friend, and at least one American destroyer was sunk by the Minneapolis as she went down. In the end a solitary American boat badly damaged was the sole survivor of the most sanguinary action on record.

Whether such a result is possible or likely in real war is an interesting question. Given the same conditions, it well may be. Each side believed that it alone had destroyers, each believed the other to be ignorant that any boats were about. Each was convinced that his plan of action was a brilliantly original idea; each was under strict orders to destroy hostile cruisers at any cost to himself. Given these conditions, the holocaust that resulted seems the only possible logical result. The range to begin with was short, it grew less as the battle advanced, and the sinking, drifting ships (as the diagrams indicate) reduced everything to a chaotic melée.

The method adopted for playing may be of interest. The ships were set up by the umpires under a cover. The lights were switched off and the cover removed. Then the players moved in gloom, speaking being strictly prohibited. Signaling was done by tapping a piece of tin attached to each model. This gave an indication of the signaler's whereabouts,

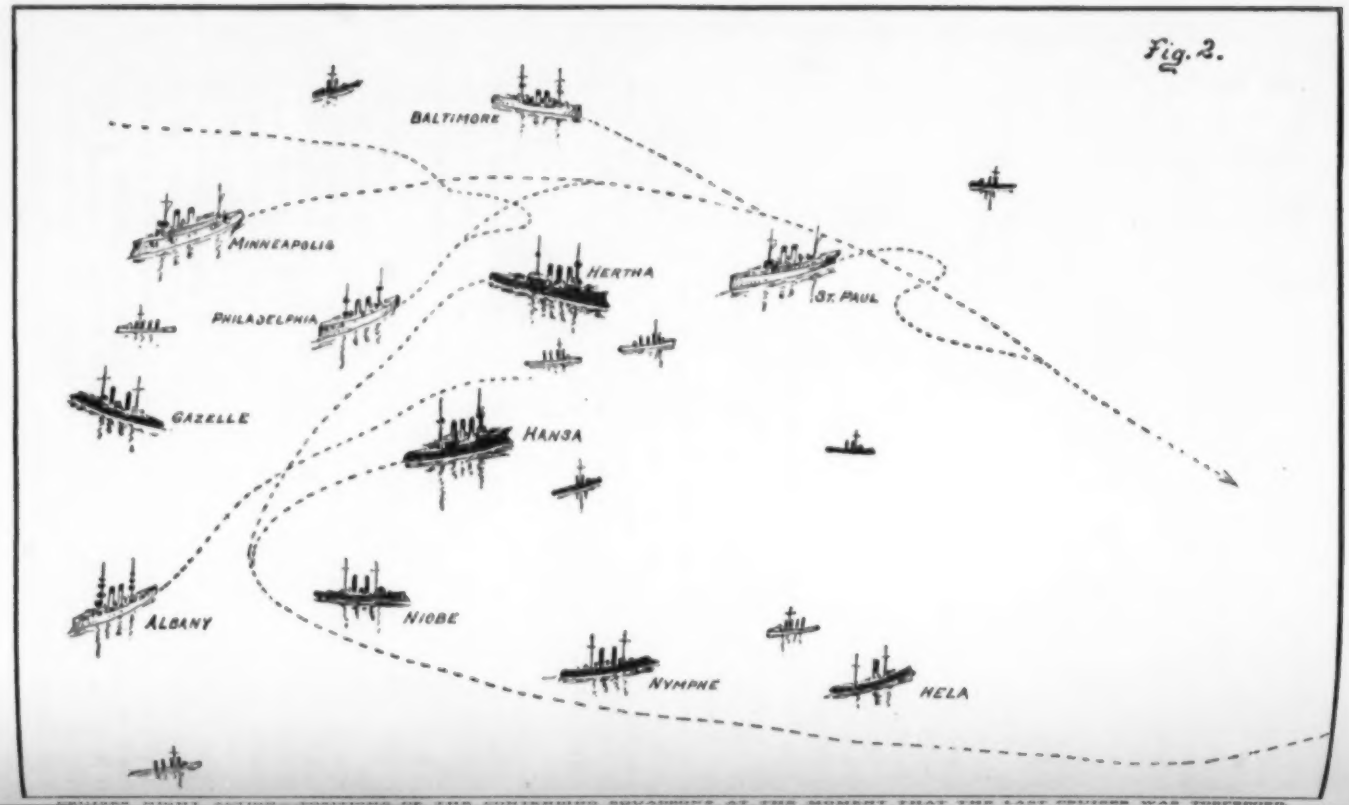


Fig. 2.
BALTIMORE
MINNEAPOLIS
HERTHA
ST. PAUL
PHILADELPHIA
GAZELLE
HANSA
ALBANY
NIOBE
NYMPHE
HELA

as the tin scintillated slightly. This rough-and-ready device worked excellently in simulating results equivalent to the real thing. For firing, the players moved to another room, the umpires, when they had gone, switching on the lights and noting positions. When the firing was over the table was covered, the players returned, the lights were switched off and the table uncovered. In the gloom it was absolutely impossible to distinguish friendly from hostile destroyers, and very hard to do so with larger ships.

Meanwhile the second German Home fleet, which had crossed the Atlantic, descended on Cuba, landing its expeditionary force near Havana. It claimed to have taken the forts in the rear and to have captured the place.

Eventually the umpires allowed this claim, on which the whole German squadron went into Havana Harbor, where it coaled and refitted after the Atlantic voyage.

The American home squadron consisting, save for the damaged Iowa and the old Texas, of the Alabama, Kearsarge, Missouri, Maine, Indiana, Massachusetts, Olympia, San Francisco, Cincinnati, Detroit, 9 destroyers, and 2 torpedo boats, concentrated at Key West.

In the Far East the first German Home fleet lay idle at Kiao Chau, whither it had retired after raising the blockade of Manila. Outside the American squadron maintained a loose blockade, trying to draw the German out—without success.

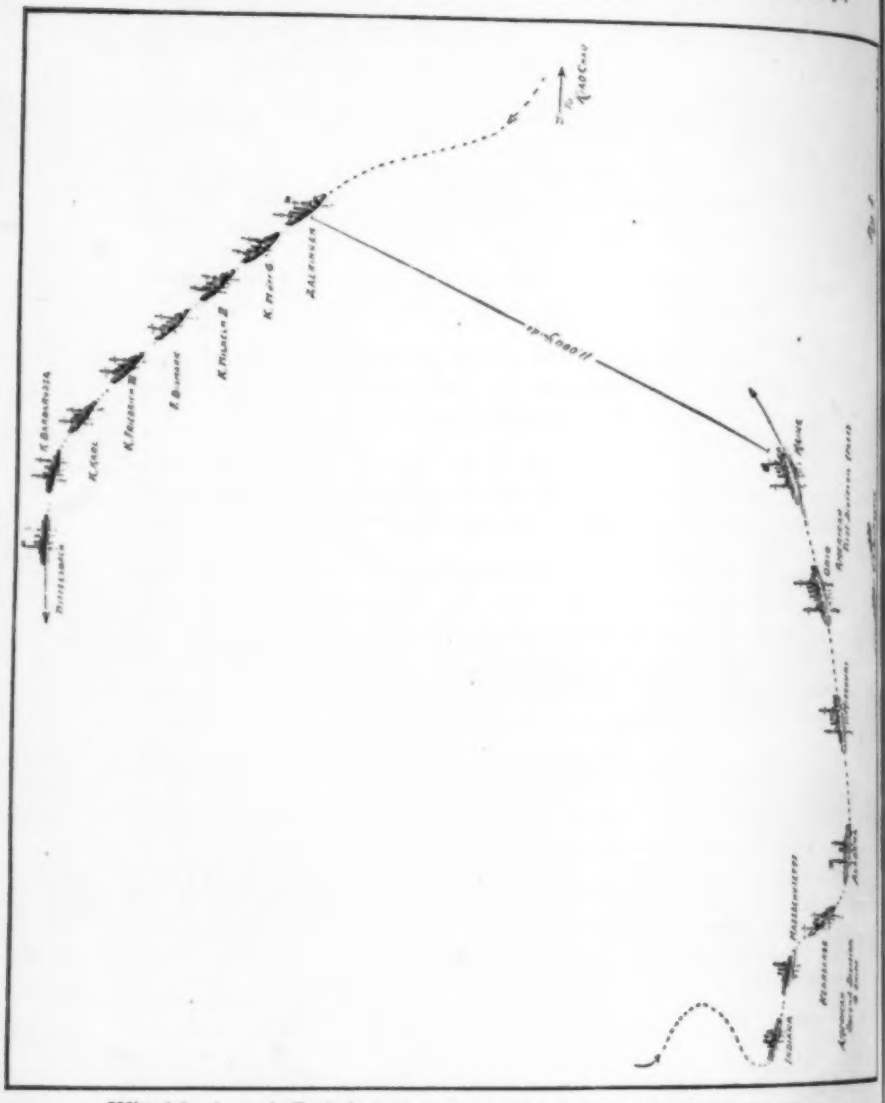
Two big battles, therefore, remain pending; both likely to be of considerable interest. The result of them will be the result of the war, it having been decided not to continue operations any further than the practical destruction of one or other navy. At both centers, however, the combatants are so equally matched that both are shy of action.

OPERATIONS OFF KIAO CHAU.

As already related, the German fleet retired to Kiao Chau, there to be blockaded by the American vessels.

This acceptance of a blockade was taken by the Americans to indicate that several German ships were so damaged at the Manila fight as to be now useless. As a matter of fact, however, this idea was only very partially correct. The Kaiser Friedrich der Dritte certainly needed repairs, but the main object of the Germans in allowing themselves to be blockaded was a strategical ruse. By means of it they secured a heavy initial advantage in ability to choose their own time for fighting, and to have that fight with full bunkers. As, however, the Americans were accompanied by colliers and were allowed their claim to have these fitted for coaling at sea, they too were enabled to keep their bunkers fairly full, and no ships had to be absent, as at off Santiago in the Hispano-American war. In one respect, therefore, the German side drew a blank. They were waiting at Kiao Chau till one of the Maine class should be absent, and for this they waited in vain. After a ten days' quietness, the Americans lying below the horizon were informed by two destroyers that were with them that the German fleet was coming out.

It came out in line ahead in the order indicated in the diagram. (In all these diagrams Kiao Chau lies to the right.) The two best ships,



Wittelsbach and Zaehringen, were at the head and tail of the line respectively; the weakest, the Kaiser Friedrich III and Fürst Bismarck, occupied the center.

This formation of a line is good, a weak "tail" being the worst of drawbacks, since it invites attack in that quarter.

The American formation-order, from this point of view, was not so good. The ships were, however, disposed to meet a different contingency, one in which speed was the principal factor. For that reason two squadrons were formed, the first of the three homogeneous and fast ships of the Maine class, the second of the remaining non-homogeneous and slower ships Alabama, Kearsarge, Indiana, and Massachusetts. Should speed be urgently needed, the American fleet was, therefore, in a position to detach a strong, swift force, one that roughly represented half its total strength.

It may not be without interest at this juncture to compare the fleets by the rate values assigned to classes in the "All the World's Fighting Ships" (Munn & Co.) classification.

U. S. Fleet.

3 Maines, Rate I at 1.0 each	= 3.0
1 Alabama, Rate I at 1.0 each	= 1.0
1 Kearsarge, Rate I at 1.0 each	= 1.0
2 Indianas, Rate II at .8 each	= 1.6
	6.6

German Fleet.

2 Wittelsbachs, Rate I at 1.0 each	= 2.0
5 Kaisers, Rate II at .8 each	= 4.0
1 Bismarck, Rate II-III at .7 each	= .7
	6.7

Bearing in mind that the Americans had the advantage of two destroyers with them against the German advantage of greater homogeneity of units, it may be said that the fleets were as nearly equal as might be.

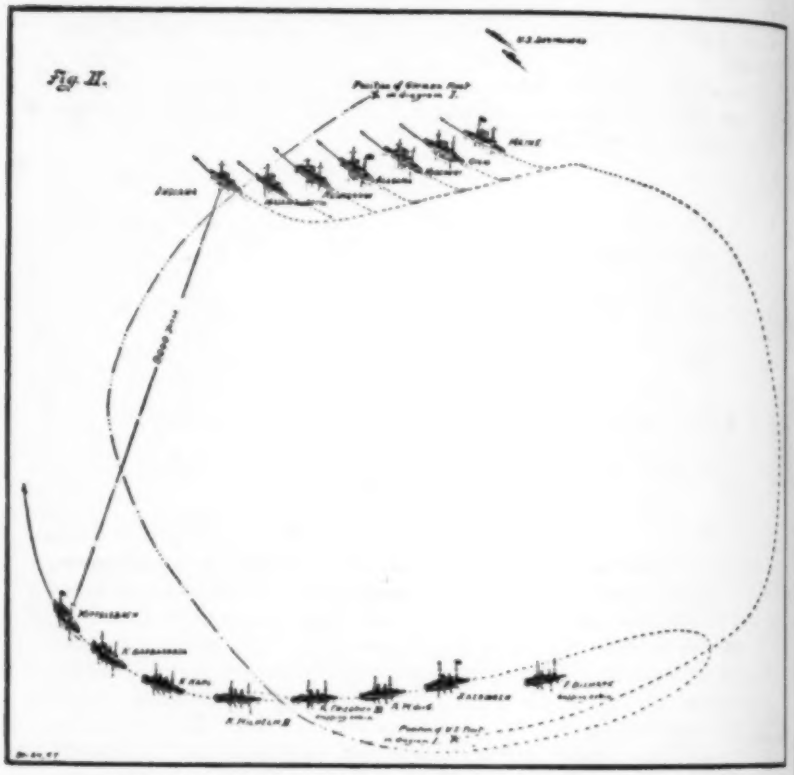
It was this equality that led to the ultimate fiasco. In view of the issues at stake, neither side cared to join issue without some considerable tactical advantage at the start. An attempt to secure such an advantage led to the interesting though abortive evolutions under review. Special interest attaches to them because of the theory, now gaining ground so rapidly in most navies, that the battle of the future will be fought and won before range is reached and before a gun is fired. The fighting, by this theory, will merely determine the magnitude of the victory.

The first tactical aim of each rival admiral was to concentrate on the tail of the enemy's line, a consummation that the Germans could have stood better than the Americans. In consequence (Diagram I) the two fleets proceeded to circle, at a range that varied from 13,000 to 11,000 yards between the nearest ships. Firing at such a distance stood to be pure waste of ammunition, and neither side attempted it.

The average German speed was considerably higher than that of the Americans, whose ships also made no attempt at top speed, doing 10½ knots while the Germans (also economical) did about 12.

Subsequently both sides increased speed somewhat, but it presently

became obvious that the Germans had the power to envelop the American tail. The urgency of defeating this, with the old Indiana class astern, excuses the next American action—a risky complete change of formation in the face of the enemy. The leading ships slowed down, turned to starboard as they did so. The tail going full speed passed on, and so became the head.



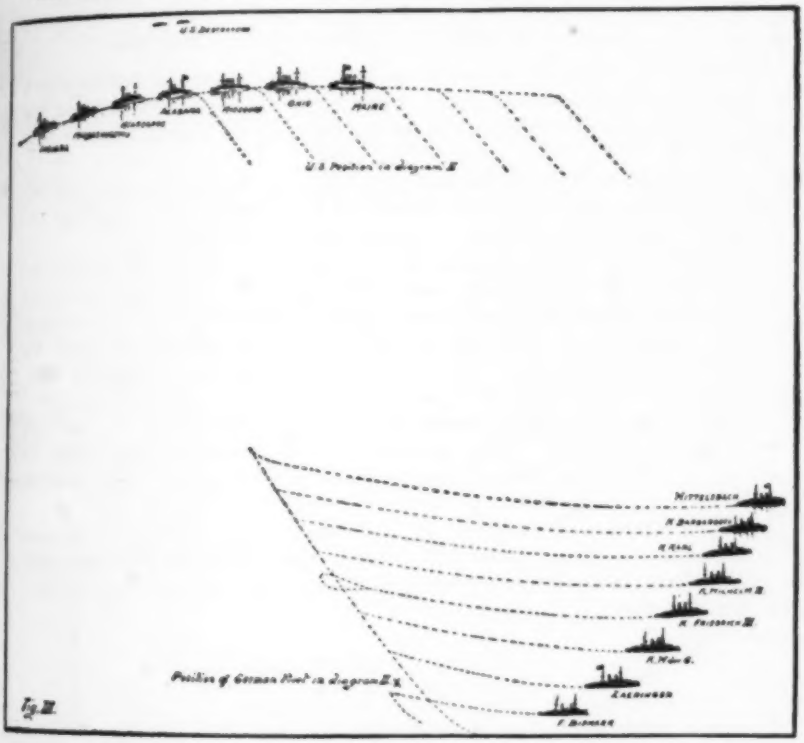
NAVAL WAR GAME. OPERATIONS OFF KIAO CHAU—SECOND STAGE.

It was a desperate maneuver, for while it was in progress ships were masking each other, and a German attack delivered while it was going on might have spelled complete disaster.

Perhaps the Germans were too far away to be able to avail themselves fully of the chance. In any case they made no attempt to do so. Instead they seized the occasion to wheel sharply (Diagram II), their efforts seemingly concentrated on anticipating the American operation by being in a position to still threaten the tail.

The German ships were now doing full speed, and decreased the range to 9000 yards, at which distance the Wittelsbach and Indiana exchanged fire, neither ship, however, doing any harm worth mention.

Owing to actions in which they had participated, the speed of the Bismarck had been reduced by three knots and that of the Kaiser Friedrich der Dritte by a knot and a half. The latter ship, therefore, had to shift station astern, while the Bismarck dropped away astern altogether. If she were left, her destruction by the Maines was probable, and the German admiral had therefore no option but to reduce speed. The Ameri-



NAVAL WAR GAME. OPERATIONS OFF KIAO CHAU.—THIRD STAGE.

can admiral, by going top speed, took advantage of this to place his fleet across the head of the German line.

A German advance *à la* Trafalgar tactics, with the object of cutting the enemy's line in two, would have been suicidal. Realizing this, the German admiral turned all his ships to starboard together, the ships to starboard of the vice-admiral's gradually dropping astern till an echeloned line abreast, a species of quarter column, was secured.

The American fleet, proceeding in an opposite direction, was not in a position to give immediate pursuit. Had it done so, there is a strong probability that the Maines would have had to contend with the whole German fleet—such an eventuality was at least the German idea.

The range rapidly increased to nearly 20,000 yards. It was then mani-

fest that the German ships were returning to Kiao Chau, to which they proceeded unpursued. That they would welcome pursuit was a little too obvious.

The reason for the retreat, as given by the German admiral, is that his original formation having been lost, he preferred to go back to harbor rather than attempt to get the Bismarck back in face of the enemy.

TORPEDO ATTACK ON THE GERMAN FLEET AT KIAO CHAU.

The next night but one after the events recorded in the last installment the American torpedo division, now raised to four destroyers and two first-class torpedo boats, made an attempt on the German fleet in Kiao Chau.

To tempt such an attack was part of the German programme, and full preparations had been made against it. To annihilate the American torpedo force meant much in the way of equalizing things.

It does not, however, follow that the American attack was foolish. The American players had been clearly given to understand that the umpires would not allow the United States torpedo craft to keep the sea indefinitely off a hostile coast; there was further the prospect that the first rough day would see the German fleet come out, easily able to disregard the boats. Finally, the rival fleets were very equally matched. The destruction of a single German battleship would have left the Americans in a position of definite superiority. After a careful consideration of these points, an attack was decided on. As the Germans had no torpedo nets, there was some promise of success.

The attack was, however, an utter failure. In addition to the land batteries there was a boom well inward. Outside of this boom were gunboats, one of which was torpedoed. The whole attacking force was put out of action.

SECOND PARTIAL ACTION OFF KIAO CHAU.

The next day the German fleet came out again.

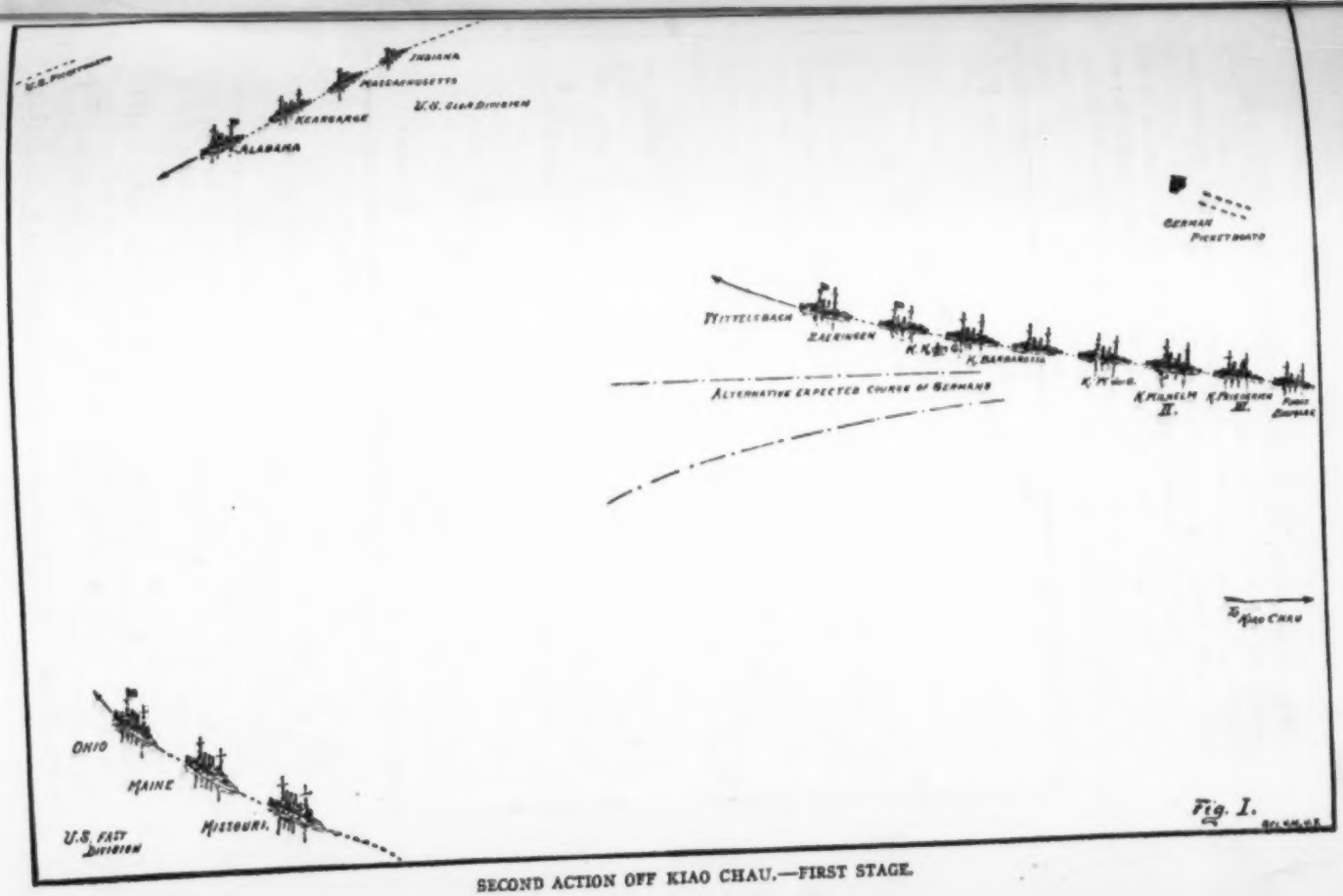
The following orders against such an event had been issued by the American vice-admiral, whose flag was shifted to the Ohio:

"The fleet will be divided into two squadrons: (A) the first consisting of the Ohio, Maine, and Missouri; (B) the slower ships Alabama (flag of rear-admiral), Kearsarge, Indiana, and Massachusetts.

"My intention is that these two squadrons are to act independently, the fast lying to the north and the slow to the south (top of diagrams) of the blockading line.

"These squadrons are to maintain a distance of about ten miles apart, until the enemy appears. Both are then to retreat slowly westward, converging slightly, but no junction is to be made and a minimum distance of 10,000 yards or more (as I may direct) preserved.

"My assumption is that the Germans will imagine that we are endeavoring to effect a junction, and that with a view to preventing this, they will try and pass between our two divisions. In such case the B division

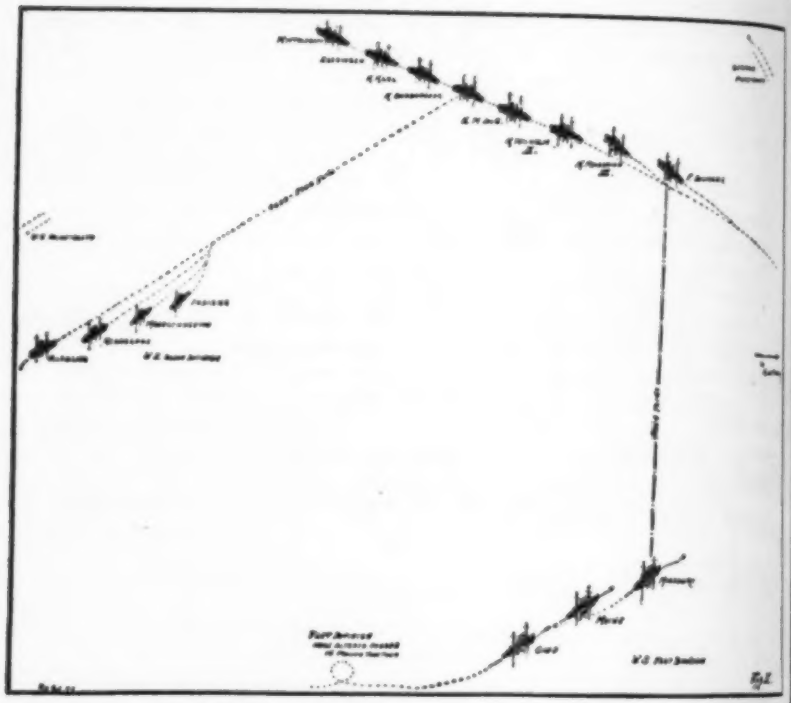


SECOND ACTION OFF KIAO CHAU.—FIRST STAGE.

(slow) is to envelop the head of the German fleet, while my own (A) attacks the tail.

"By this means I hope to force a general action, that otherwise seems likely to be postponed to our disadvantage.

"The picket boats of the squadrons are all to lie well west of the slow division. Toward the end of the action, or at such other time as may seem necessary, they are, at the discretion of the officer in charge of the boats, to close in and torpedo the enemy.



SECOND ACTION OFF KIAO CHAU.—SECOND STAGE.

"It is possible that the enemy may, instead of seeking to pass between the slow and fast divisions, attack one only, probably mine. In such case the division attacked is to bear away from the enemy in such formation as may give the best return fire in the circumstances of the case, until the other division has approached sufficiently near for the original plan to be carried out."

Thus the orders of the American vice-admiral, whose tactics, it will be noted by those conversant with tactical theories, were of a French type. The special advantage of these tactics is that they give an appearance of weakness that does not really exist.

The German fleet came out, with the Wittelsbach and Zaehringen lead-

ing—each flying a vice-admiral's flag. The rest of the ships were arranged in order of speed, the slowest at the tail. They were in single line ahead, and, contrary to anticipation, not only displayed no desire to cut the line, but steered in such fashion that the tail only of the slow American division would be in range of them. The first impression conveyed was that they intended to avoid action altogether. The discovery that the Germans also had their picket boats out dispelled this idea, but for a time their objects were quite undiscernible. They were then (Fig. 2) going at top speed, tailing out. Seeing this, the United States slow division reduced speed slightly, while the fast division, doing its top speed, altered course sixteen points, steering to concentrate on the German rear ships.

The United States rear-admiral signaled that it would be impossible for him to attempt to envelop the German head, at the speed the hostile fleet was going; plans were then hastily amended, and a concentrated fire ordered on the German rear ships.

The effect of this fire was soon felt by the sternmost German ships, Kaiser Friedrich III and Fuerst Bismarck, but the Massachusetts and Indiana suffered little less. All four of these ships were badly mauled and dropped out of station.

Then it was that the American vice-admiral signaled: "Delay action; hostile picket boats must be destroyed before battle is engaged."

A chance to cut off the German boats occurred and he—wisely—made the most of it, and finding that the main body of German warships kept on, he signaled for his whole fleet to sink the now separating hostile picket boats. This was eventually accomplished without loss to the Americans, at the expense of a distribution that might have been serious had the Germans suddenly returned.

The German fleet, however, was busy chasing the United States picket boats, and did not destroy these till it was a long way from the field of battle and as divided up as the American fleet.

Meanwhile the four disabled ships (Fig. 3) were closing on each other. The American vice-admiral signaled to inquire whether his two could settle the two Germans, and receiving a reply in the affirmative, ordered the Alabama and Kearsarge to join in the attack upon the picket boats—his idea being that these constituted the gravest danger, and that it was beyond all things desirable to keep as many battleships intact as possible.

The two German vessels, keeping the disabled Americans between them and the remainder of the United States slow division, closed in, bows on. It was then discovered that they had a superiority of gun fire, and the Massachusetts signaled to the Kearsarge for immediate assistance. Before this ship could get round with a clear target the Germans had reached torpedo range. The Americans made the better shooting, and practically wiped out all the German bow fire, reducing the attack to dead slow. The torpedo efficiency was not, however, impaired, and the Indiana was hit and went down. The returning Kearsarge got a broadside into the Bismarck that settled her. She then devoted attention to the Kaiser Friedrich, now coming very close to the Massachusetts. A torpedo destroyed that ship also—again from the bow submerged tube. Immediately it was

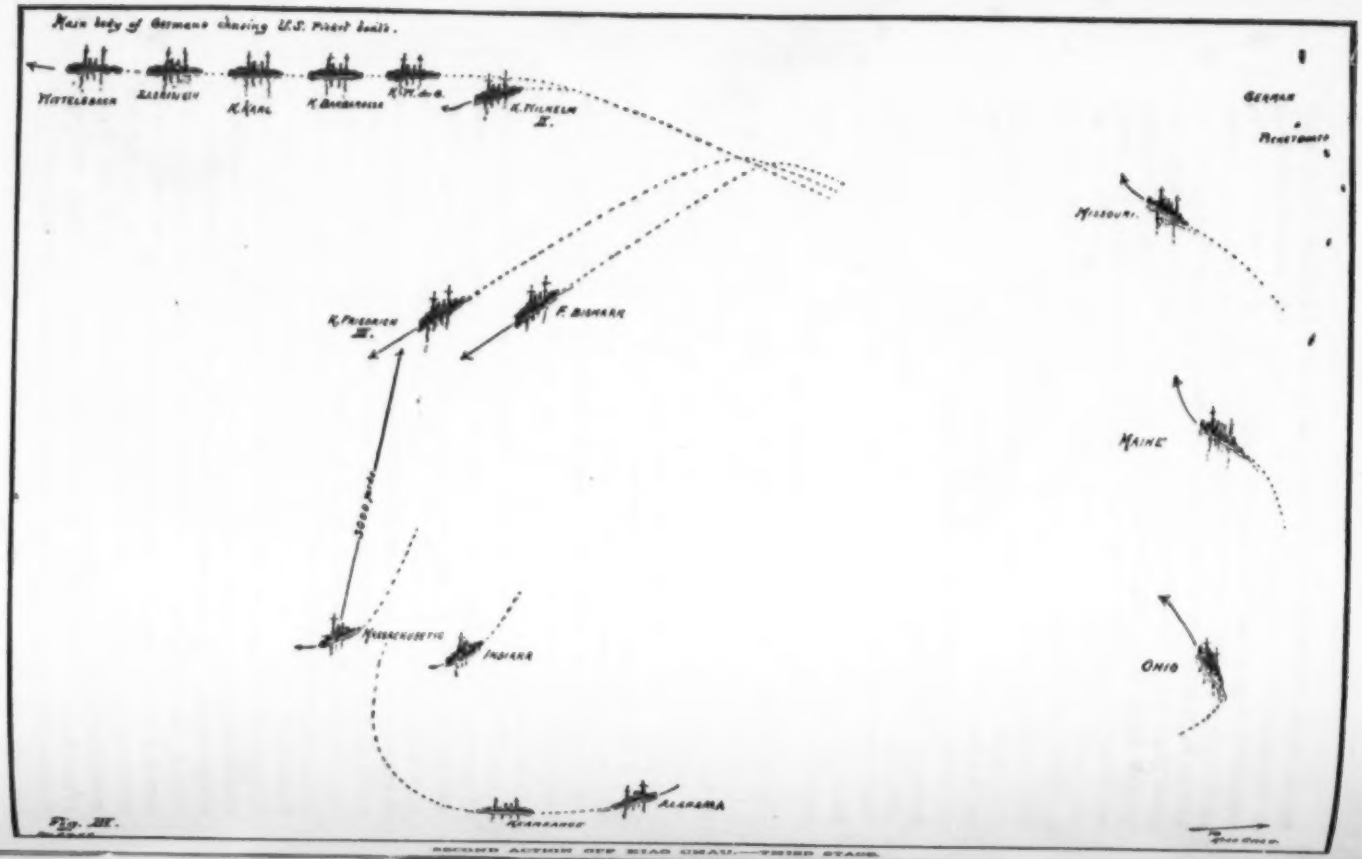


Fig. III.

SECOND ACTION OFF STAG CHAU.—THIRD STAGE.

seen that the Massachusetts was sinking, the Kaiser Friedrich III struck, and was taken possession of by the Kearsarge. She was an absolute wreck, worth next to nothing as a capture.

By the time this incident and the destruction of the German picket boats was over, the main German fleet was hull down, leaving the Americans to surmise as to their next intention.

Already during the "war" the players of American vessels had noticed with dismay the immense superiority of the German vessels in torpedo armament. One American fleet had been lost through the torpedo (see the cruiser action in mid-Atlantic), on other occasions American torpedo inferiority had proved hampering. There was therefore at once a general guess that the Germans would be back with the night, and under cover of the darkness endeavor to secure that victory which superior average speed and superior torpedo armament might promise, and which their inferiority in guns and armor rendered unlikely in a combat confined to those weapons.

This surmise was correct; the German intention was a night torpedo fight.

GREAT AMERICAN VICTORY IN THE FAR EAST.

Following upon the partial action recorded last week, the American fleet prepared for the expected night action that the Germans were bent on forcing.

At sundown the German fleet was visible on the horizon—the main body a long way off, with two ships, taken for the Wittelsbach and Zaehringen, somewhat nearer, acting as the scouts of a fleet devoid of cruisers.

The U. S. S. Maine, Ohio, and Missouri, pressed toward these at full speed, the rest of the American fleet following astern as well as it was able.

The two German vessels, in no way anxious to try conclusions with the three Maines, fell back toward their main body. This move being well in progress, the two slow American ships Kearsarge and Alabama turned about, making for a rendezvous. This they succeeded in doing without observation.

The three Maines meanwhile continued to press as much as was safe, and by nightfall were little more than ten thousand yards from the Germans, who presently stopped, and then started to close on the Americans.

Then the Maines beat a retreat, drawing the Germans away from their two slow consorts.

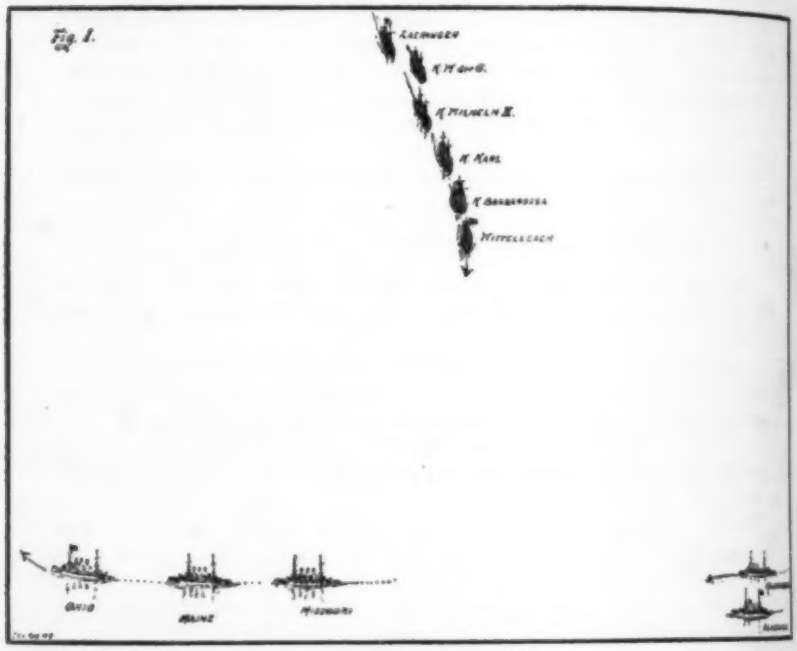
The move was an exceedingly daring one; however, the American admiral was so nervous as to the almost inevitable result of a torpedo contest that the circumstances may be said to justify it more or less.

In any case results did. The Maines, keeping a straight course at full speed were easily kept in sight by their antagonists, who gradually began to tail out, only the two Wittelsbachs being allowed a steaming power equal to that of the Maines.

About midnight the Maines began to curve toward the rendezvous, and by two o'clock some of the German vessels were able to act on interior lines sufficiently to press.

This continued till about three, about which time one of the German players, the Zaehringen's, made an error in moving which, by the rules, constituted an engine-room breakdown. On this the Germans abruptly ceased the chase, altering course sixteen points together.

This they did very suddenly, and by a subsequent alteration were able to get entirely out of touch of the Americans, who vainly tried to pick them up again. The Maines therefore proceeded to the rendezvous, and picking up the slow ships, returned to their old cruising ground off Kiao Chau.



THE GERMAN ADVANCE.

The German admiral claims to have decided to withdraw before the Zaehringen broke down, an idea of a trap having occurred to him.

ATLANTIC MOVES.

In the Atlantic nothing further has happened. Armed liners have chased each other without result, but the main German fleet still lies at Havana, while the Americans as persistently stick to Key West.

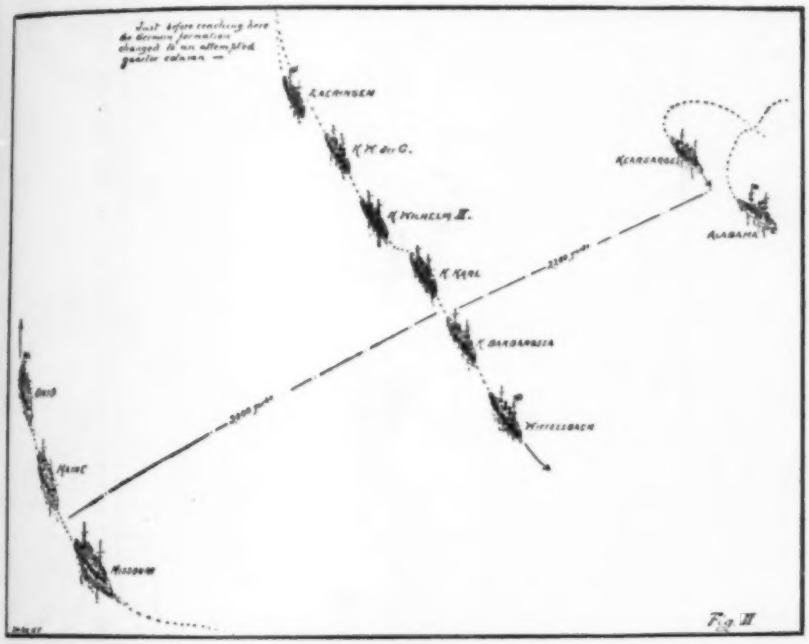
The real reason of the German inactivity is that the umpires have reduced the speeds of several ships on account of Atlantic voyage, and put several destroyers temporarily *hors de combat*. The Germans are compelled to wait till these defects are "repaired," but the reason not being known to the Americans, wild surmises can alone obtain.

As for the American admiral, he is by no means anxious for an early fight, being glad of any opportunity for farther thought about how his fleet of monitors and armed liners can best go into action.

PRACTICAL ANNIHILATION OF THE GERMAN FLEET.

On the morning following the night operations above referred to, the American and German fleets sighted each other off Kiao Chau.

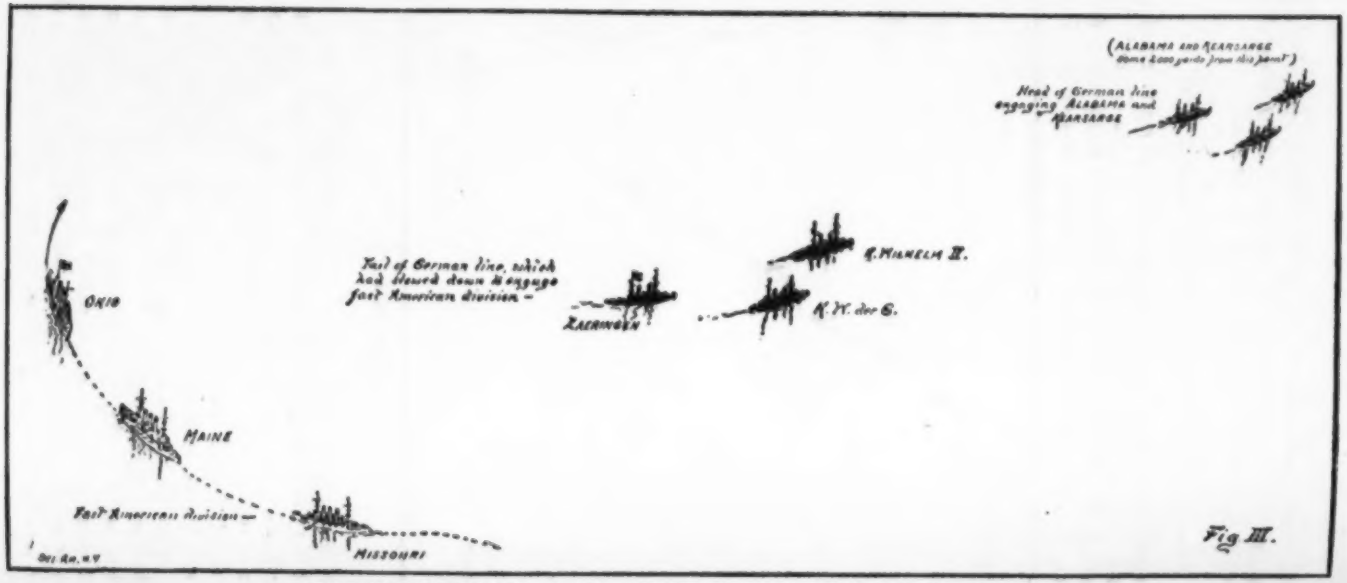
The American fleet was in line ahead, the order being (first division) Ohio, Maine, Missouri; (slow division) Alabama, Kearsarge. The Ger-



CUTTING THE LINE.

mans, when first sighted some 12,000 yards away in the dawn were in line abreast, the Wittelsbach and Zaehringen at the wings, the rest of the ships, four Kaiser class, in the center. On sighting the Americans they altered course together into line ahead, steaming very fast so as to get round and ahead of the American line.

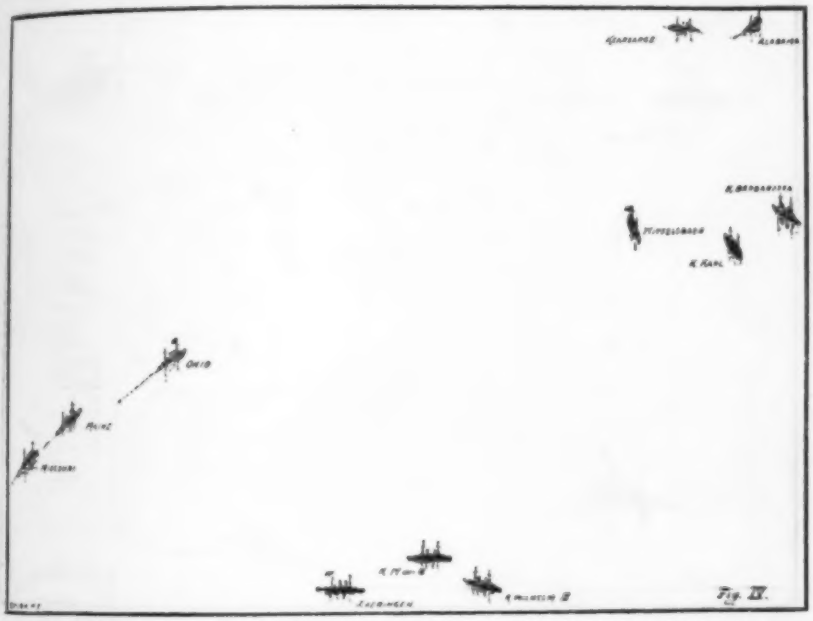
In part with a view to prevent this, in part with a view to the carrying out of the tactics that he had in view, the American admiral put on full speed in the Ohio, Maine, and Missouri. The result of this was that a gap was left between these ships and the Alabama. This gap grew greater still when the Alabama was seen to haul out of line and gradually drop astern of the Kearsarge. (Fig. 1.) This particular move it was that decided the issue of the battle. Had the Alabama kept her place, it is



THE AMERICAN FAST DIVISION ROUNDING THE TAIL OF THE GERMAN LINE.

likely enough that the German admiral would have suspected something; seeing the Alabama dropping, he fell into the trap prepared for him, and took it for granted that the Americans were making a full speed rush for the head of his line.

Round at once came the German fleet. There was a chance to "cut the line," and the temptation to use this classical attack was irresistible. Fire was opened, therefore, with the German line impinging at right angles on to the American one, and the cutting off of the two slow Americans looked a certainty. (Fig. 1.) On the other hand, every American vessel was able to bear in detail on the approaching vessels.



POSITIONS WHEN FIRST DIVISION WAS ABOUT TO COMPEL GERMAN TAIL TO STRIKE.

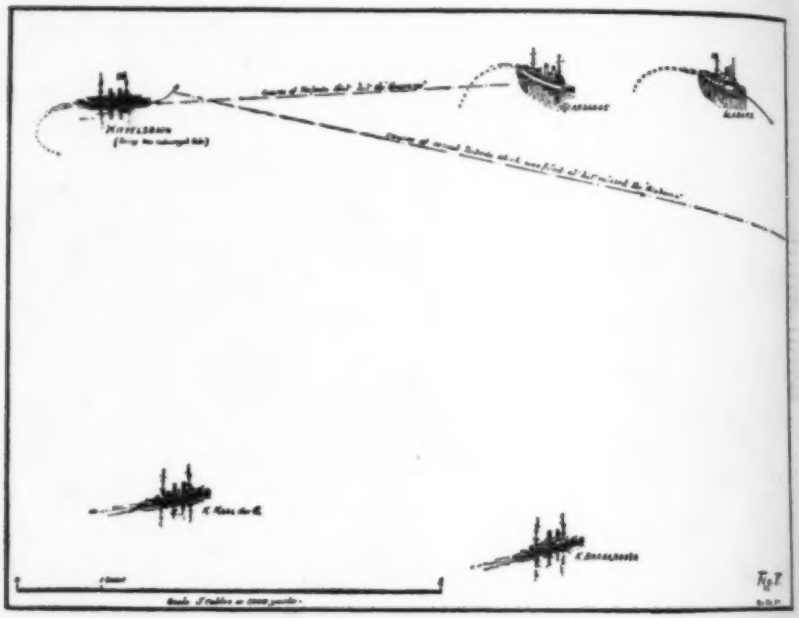
The situation, from the American standpoint, was now a delicate one. There was a risk of the German admiral realizing his error, there was also a risk that he would go astern of the Alabama, in which case the destruction of the two lame ducks was certain.

With a view to preventing this, some considerable *finesse* was necessary, and it was certainly displayed. The three Maine class began to swing round, and a great show was made of an attempt to join up the threatened line. Still more cunning, however, was the American fire system. By this only the Kearsarge fired at the German flagship, all the other ships pounding the Kaiser Barbarossa and Kaiser Karl der Grosse, the second and third ships in the German line. By this means the German admiral,

little hurt himself, did not immediately realize the situation into which he had tumbled.

He had, indeed, cut the line before he realized it. Then (Fig. 2) realization was too late. Turning to port, the Kearsarge and Alabama engaged the first three Germans; bearing to starboard on the other side, and going in the opposite direction, the Ohio, Maine, and Missouri, engaged the Kaiser Wilhelm II, the Kaiser Wilhelm der Grosse, and the Zaehringen.

The range was kept at 3000 yards, out of the torpedo zone. The American gun fire was the more powerful, and presently rounding the stern



FIFTH STAGE. TORPEDOING OF THE KEARSARGE (ON EXACT SCALE).

of the Zaehringen, the three concentrated on and demolished that ship. The leader of the second line, the Kaiser Wilhelm II, was unable to steer, and here matters resolved themselves into a pounding match, the odds ever growing against the Germans. At last their fire ceased, and the Zaehringen hoisted a white flag. What was left of this division had surrendered.

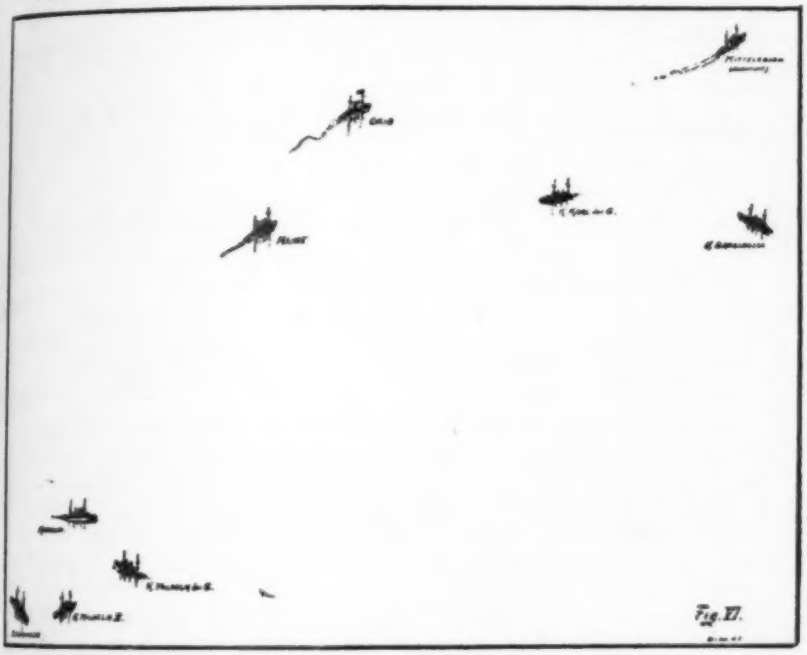
SEVERE DEFEAT AND DESTRUCTION OF THE GERMAN FLEET IN THE FAR EAST.

With the other divisions things did not go so simply. Battered as were the two Kaiser class ships, the Wittelsbach was practically untouched. The American vessels were by no means so well off, both of them had received big shells in their R. F. batteries, and the after turret of the Kearsarge was out of action. Of all five combatants only the Wittelsbach was in perfect steering trim.

Of this the Wittelsbach took instant and brilliant advantage. Going full speed she was soon astern of the Kearsarge, which could not reply with a single gun, her stern being demolished or nearly so.

At 1000 yards the Wittelsbach slowed down and fired her bow submerged tube. It took effect, and the Kearsarge went down.

This left three Germans pounding the Alabama, now in a bad way. Circling round, the Wittelsbach fired a broadside tube at her which missed. She then came back to her original course and drew nearer. The Alabama meanwhile got off a torpedo that hit the extreme bow of the Bar-



SIXTH STAGE. POSITIONS AT THE END OF THE BATTLE.

barossa, but she was so pounded that but for the fact that the Ohio was hurrying to her assistance, she would have been captured.

Seeing the Ohio coming up, the Wittelsbach rushed the Alabama, giving her two more torpedoes, both of which hit. The Alabama went down.

For a little while the Wittelsbach and what was left of the Kaiser Karl der Grosse engaged the Ohio, which kept well out of torpedo range, concentrating mostly on the Kaiser Karl der Grosse—the Kaiser Barbarossa being past firing. One 12-inch A. P. shell was, however, got into the Wittelsbach's battery, whereupon this ship began to make off for Kiao Chau, her consorts having signaled that there was no more fight left in them.

The Ohio followed a little way, but a 9.4 shell hitting her conning

tower put her out of control and killed the admiral. She fell off, and the Wittelsbach—which had the speed gage at this stage—got clear away. The other two German ships, from one of which the fatal 9.4 had come, surrendered so soon as they saw the three Maines reforming to attack them.

Thus the command of the sea in the Far East passed to the Americans, and passed relatively cheaply. Out of the five ships they lost the two weakest sunk, and one other, the Missouri, badly mauled. Two were left in fair fighting trim. The Germans, on the other hand, lost five of their six ships, one, the Kaiser Barbarossa, sinking soon after the battle, and the ship which got away was in no trim for fighting for many a long day.

Both American admirals had perished, the vice-admiral killed, the rear-admiral drowned in the Alabama. The senior surviving captain in the Maine was therefore in command. He at once dispatched the damaged Missouri to San Francisco with the prizes, and himself went to Manila with the two intact ships. Here, as he had expected, he received urgent orders to proceed back to the Atlantic without delay. Here the Germans, eluding the monitors without difficulty, were doing serious damage on the seaboard.

A summary of the guns engaged is as follows:

	13-in.	12-in.	9.4-in.	8-in.	6-in.	5-in.
United States	8	12	—	4	62	14
German	—	—	24	—	108	—

In this, it will be at once apparent that the Germans had a great rapid-firing advantage, while with armor-piercing guns the Americans had the pull. In tertiary pieces (3.4 and 3-inch) the Germans were vastly superior.

This fact determined the American admiral's decision to have his line cut if possible. It gave him a chance to come in with his big guns before these were overwhelmed by the rapid-firers, and he succeeded in accomplishing it.

At first sight the position of the Germans with both broadsides in action looks extremely advantageous. But the advantage is apparent only, because of the disadvantages suffered in getting to the position, and the further disadvantage that immediately followed it. What really happened was that both American divisions as they turned were able to concentrate on the fourth and fifth German ships (the second and third being then feeble), and so soon as there was danger of the United States divisions hitting each other, the Alabama division was able to attack the head and the Maine one the tail of the enemy. Thus the Germans were split up into two, and between the effective Wittelsbach and Zaehringen were four disabled ships. Concentrated German torpedo attack was thus avoided. The different torpedo armaments were:

	Submerged	Armored Above Water.	Unarmored Above Water.
United States	6	8	1
German	30	6	—

Both sides were allowed the safety pistol for above-water tubes, and all these were loaded except that in the Kearsarge's bow. Most above-water tubes were smashed at an early stage of the battle.

The damages received by the captured German ships were of such a nature that they will be of no further use for some time to come, and unless the war is indefinitely prolonged (which is extremely improbable) they will certainly have no share in it.

It remains to add that the Americans just after this battle were allowed by the umpires to have refitted the Kaiserin Augusta, captured in the first battle of the war. A speed of 15 knots, and an effective battery of ten 6-inch guns, has been allowed her. The ship is at Manila.

The Germans have been allowed the Detroit, captured in that mid-Atlantic cruiser action which resulted so disastrously for America. Her speed has also been fixed at 15 knots, and the effective armament reduced to eight 5-inch R. F.

A German cruiser squadron with the Victoria, Luise, Gefion, Ariadne, and Detroit—all repaired ships—is fitting out at Kiel.

Owing to the numerous battles and heavy losses on both sides, the relative value of every ship has gone up a good deal and this squadron is already being viewed with apprehension by the Americans. Still the decisive victory in the Far East has done much to render American sea power more secure, and if the German vessels on the East Coast could only be brought into action, all serious danger would be averted. The problem is, however, a difficult one, the monitors being so far impotent, and the rival torpedo fleets merely neutralize each other.

TORPEDO ACTION OFF KEY WEST—MUTUAL DESTRUCTION.

The tendency of torpedo craft to neutralize each other has been very marked throughout the whole war, and it has persisted to the closing stages.

For convenience, while operating on the eastern coast the Germans made a special division of their torpedo craft, which lay well outside, a dozen destroyers under convoy of the liner Deutschland, while the heavy ships raided the coasts. On the flanks of these the American destroyers to the number of thirteen, conveyed by the armed liner St. Louis, continually hung, but any attempt at a general action was defeated by the fact that German cruisers moved out.

All that happened therefore for some time was a series of isolated duels, usually ending in mutual destruction. By this means the Americans were reduced to seven and the Germans to six boats.

At last, however, the German fleet saw fit to return to its Havana base, which it did well out to sea, sending its destroyers more inland. The American boats had disappeared for a day or two, and the greater number were believed to be sunk; so that German wariness was relaxed. It was due to this that the American division was able to encounter the German one.

Orders were to sink the German boats regardless of cost—these boats being enough menace to keep the monitors inside Key West. Consequently

the encounter from the first assumed the nature of a general massacre. The sea was somewhat rough, and, though the destroyers sought to engage each other and torpedo the big liners, what actually happened was an indiscriminate *melée* in which the Deutschland sank American boats and the St. Louis German ones. More than once friends were fired on by mistake; in the absolute jumble that ensued it was well nigh impossible to distinguish friend from foe. Both sides had discarded ensigns—these being found to attract the hostile liner too surely. There were also one or two attempts to reach the liners under false colors, which increased the confusion, for the liners, detecting the ruse, grew panicky, and fired almost indiscriminately. The only "method" in all the fight was that these two monster ships carefully avoided one another—driven to this by mutual fear of the result of an encounter. Both, it also happened, had orders not to bother about each other, but to sink destroyers.

The net result was that in twenty minutes no destroyers were left. Then, and not till then, the liners began to pay attention to each other, firing as they circled round each other at extreme range.

A few trifling upper work hits were secured, but nothing of moment occurred till the Deutschland got a shell in her charthouse which destroyed the wheel. At this she flew off at a tangent and made off to Havana.

The captain of the St. Louis was relieved of his command for not having done more; but it is difficult to see what he could have effected, since the German had the speed gage. However, the fact that he had sunk by mistake two American destroyers seeking cover near him settled the case against him; those who had not witnessed the battle refusing to believe the ease with which mistakes could be made.

As for the battle, it is extremely difficult to discuss it, because there are directly antagonistic opinions as to whether or no it simulated properly real war results. German destroyers are very unlike American ones, and have the masts in different positions. All who did not see the fight have argued that in actual fact the mistakes that marked the action could not have occurred. But in the battle correct models were employed, and the conditions were reasonable enough. All moves were made by time—in 30-second moves. In those 30 seconds each player had to move his boat to time and indicate the craft he fired at—a good deal to do in one half-minute. He also had to keep a sharp lookout for disabled boats drifting about, and to be wary of the attacking liner. Consequently every boat coming toward was apt to be taken as a foe, every boat moving in the same direction as a friend. A slight disabled German boat noting this, turned and accompanied the Americans, with a brilliant notion of thus sinking several of them. Instead, she was sunk by her own friends. There was no time, sometimes no opportunity, to note the funnels or mast of the advancing model. To do so probably entailed loss of fire, and loss of fire was a fatal error.

On the whole, few of those who participated grumbled much at the conditions laid down, and most agreed that they made no unfair simulation of real war as understood and anticipated by them.

As remarked above, it is hard to say conclusively that the results were real or unreal. If real, then the irresistible conclusion is that torpedo

craft will have value in the next war only for destroying each other, and after one side has lost all its boats—that at the most they cannot be assigned a higher value than the pawn has in chess, without the pawn's ability to become a king. Now the value of a pawn outside that is not very great with players of equal ability, as they can be set off against each other, and always there is considerable increase of value only when all the pawns of one side are taken or completely neutralized. Otherwise their value is of a defensive nature chiefly, and the defensive is ever the side that loses in the long run.

A noteworthy incident of these operations was the high value exhibited by the big liners as destroyer-destroyers. The idea of this use seems to have been well grasped by both sides, and so little respect was there for the orthodox rôle of "armed cruisers" that the first claim made by both sides was to take out most of the 6-inch and 5-inch guns from these craft and substitute enormous batteries of anti-torpedo craft guns—14 pounders and the like.

The above battle was a distinct advantage to the Americans. Their remaining torpedo craft were not immediately available, but free from the German torpedo menace the monitors were now able to put to sea without fear of being torpedoed.

With the Iowa and Texas the monitor fleet, directly moderate weather was recorded, went off Havana, offering battle—a gage that the Germans cheerfully accepted. For America, the salvation of the east coast depended on crippling the Germans; for Germany, with the prospect of having to fight the two Maines, now near the Horn, it was altogether desirable to destroy the monitor fleet that else would intercept them on returning after battle to Havana. Moreover, there was a very strong risk of the recapture of Havana, once the German fleet went away to battle elsewhere.

And so began the most curious battle of the war, on one side orthodox battleships and cruisers, fast and fairly well supplied with heavy and R. F. guns, on the other a heterogeneous collection of monitors of varying date, the old ram Katahdin, and some submarines—a fleet very nearly devoid of quick-firers, slow and unwieldy, but hard to hit and with a preponderance of big guns. And to add to the strangeness, each side was firmly convinced that it would secure an easy victory.

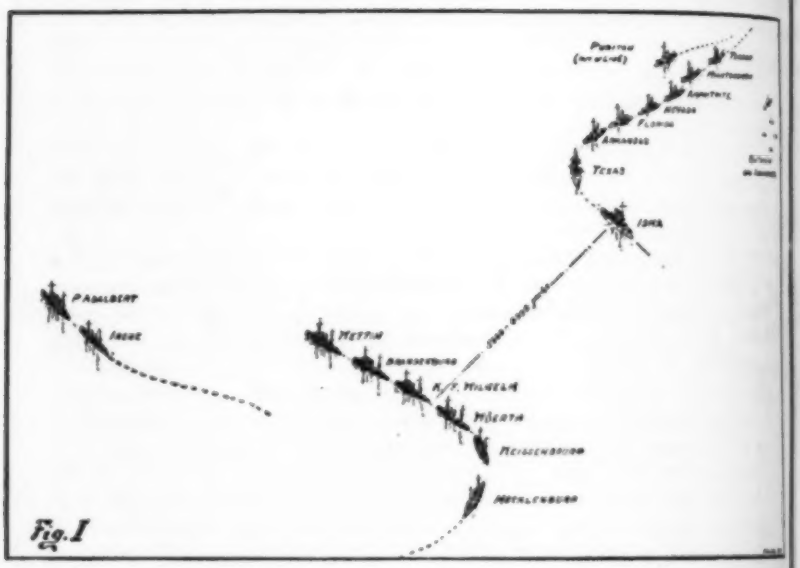
MONITORS AND SUBMARINES IN ACTION IN THE FINAL BATTLE—VICTORY FOR THE AMERICAN FLEET.

The American fleet was formed into a single line, led by the Iowa, the Texas, Arkansas, Florida, Nevada, Puritan, Amphitrite, Miantonomoh, and Terror following. The weaker monitors were kept astern, so that they should not come into close action until the first edge of the enemy's fire should be reduced. The Katahdin and submarines kept on the off side.

The German formation—also line ahead—was as follows: Wittin (flag), Brandenburg, Kurfurst, Friedrich Wilhelm, Woerth, Weissembourg, Mecklenburg, with the Prinz Adalbert and Irene as a detached squadron a little ahead and further from the foe.

The speed of the Americans was 7½ knots; the Germans maintained just double that—15 knots.

The fleets met almost bow to bow, the Germans circling as range was reached. By this means every ship got a fire into the Iowa and Texas, which, hampered by having to keep with the monitors, were unable to turn away quickly enough to bring the latter into action. So it came about that "first blood" cost the American fleet its two battleships, which were totally disabled right away. The Germans on their side suffered comparatively little, but two 12-inch A. P. from the Iowa almost wiped out the Wettin's R. F. battery.

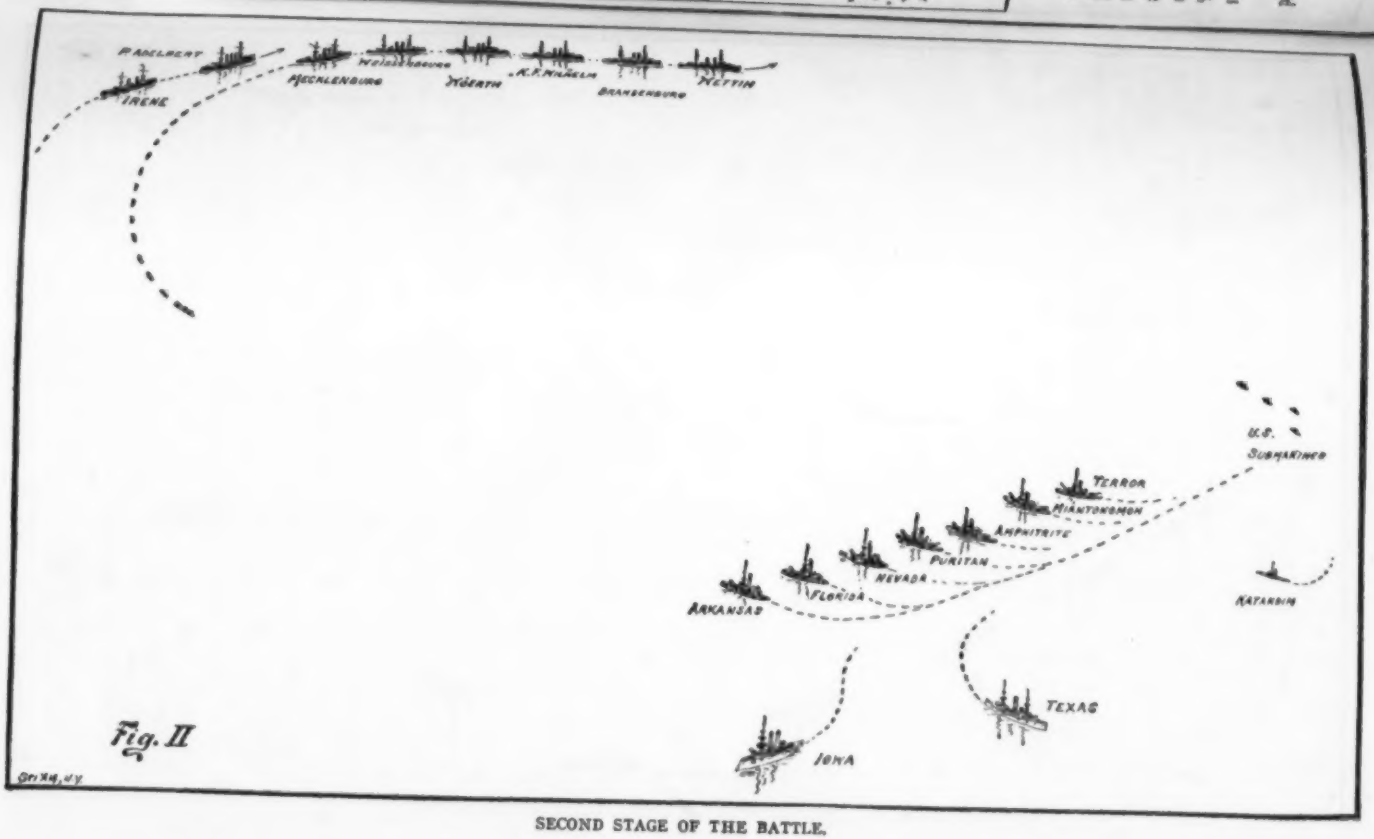


OPENING STAGE OF THE FINAL BATTLE OF THE WAR.

Having delivered their fire, the Germans circled away out of range. When they returned, the tail of the American line was their attack.

To meet this the American admiral gave up steaming altogether, using his ships as floating batteries, except that their screws were used to keep them turning from bows on to broadside and back again. By this means the bow turrets were constantly in action, while the after ones in such ships as had them secured a relative amount of protection.

Across the zone of heavy gun fire thus formed the Germans came. They concentrated on the weaker monitors, and gradually sank them, but only very gradually, for they were very hard to hit. By the time they had done so, all four Brandenburgs were in a bad way, and the Prinz Adalbert little better. The Irene, hit by two 12-inch shell, disappeared altogether. Then it was that the Katahdin ram came out; but as the very first hit cut away her smokestack, her speed, never great, became very low, so that the still



SECOND STAGE OF THE BATTLE.

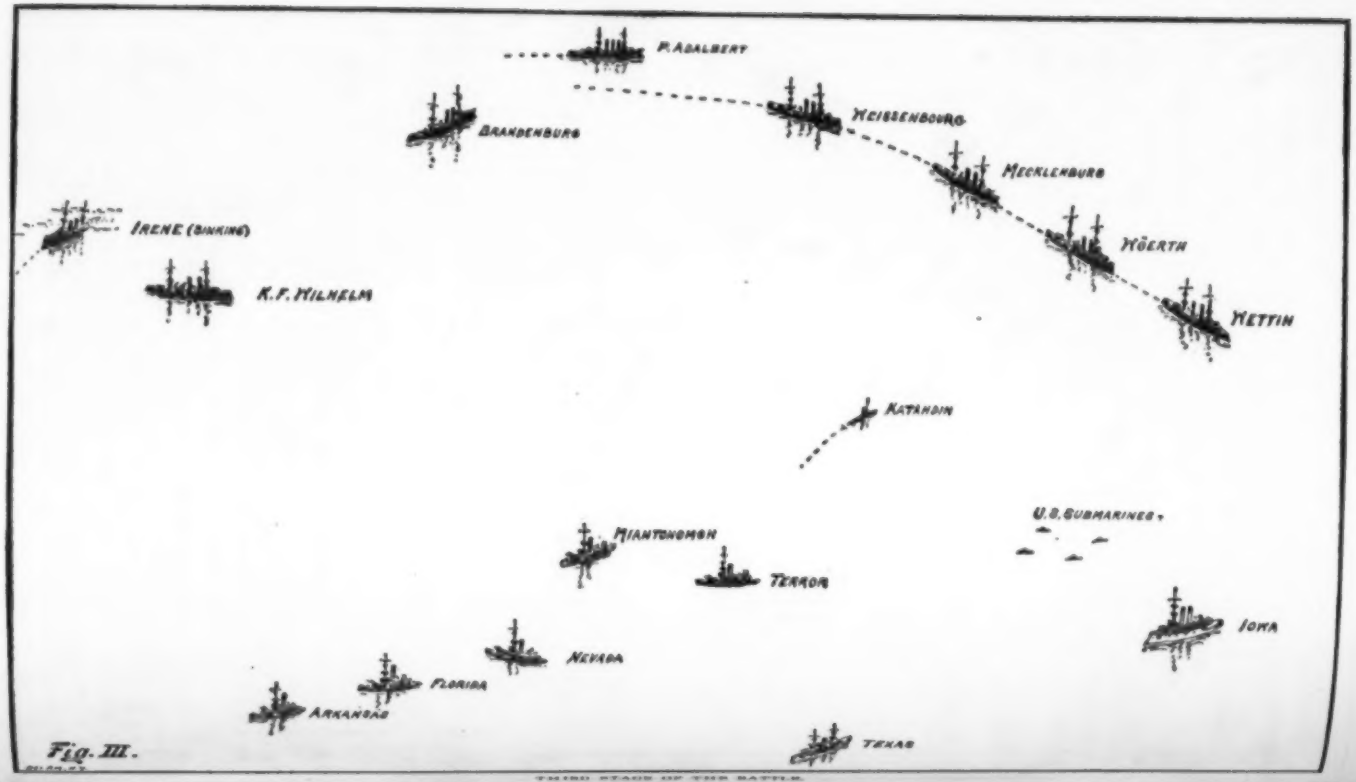


Fig. III.

THIRD STAGE OF THE BATTLE.

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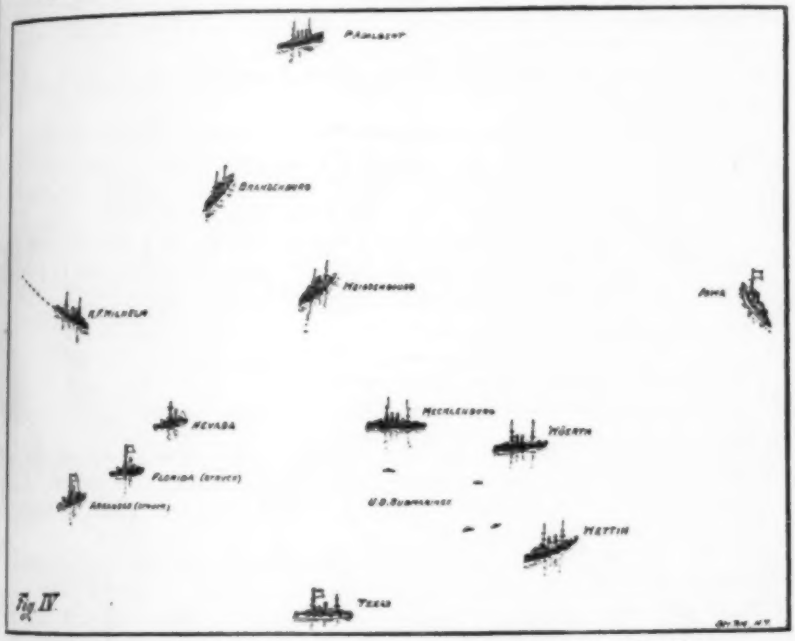
Fig. IV

militant Germans, having the speed advantage, easily avoided her. She might, it is true, have acted against the disabled Brandenburgs, but her orders were to worry the ships still in action. In the end a lucky 9.4 ripped up the Katahdin, and she sank.

By this time both sides were tolerably impotent, but what was left of the Germans got round astern of the three remaining monitors. These—all of the Arkansas type—had either lost their big guns or were unable to turn. Their topsides were blown to pieces, but their belts being still sound they floated all right. The Germans were too far gone to use torpedoes, and few if any big guns remained to them. One or two R. F.



FOURTH STAGE. MONITORS STRIKING, SUBMARINES TO THE ATTACK.

still fired, but these had long ago done all that they could. As a last forlorn hope, the Germans tried to end the deadlock with the ram.

To do this more effectually, they first of all stopped, so as to get into some kind of line. This gave opportunity to the four submarines, which the Germans had never suspected, and the Americans given up as lost. Indeed, the Florida and Arkansas had hoisted white flags, when the first submarine rose alongside the Wettin and disposed of her. The Mecklenburg and Woerth were similarly disposed of before the Germans realized their danger. Then they struck—there being nothing left to do. Before this happened, however, the Mecklenburg had managed to drift into and ram the Nevada—both these ships going down together. This final stage of the battle is graphically depicted in the engraving (Fig. IV).

A summary of the guns engaged is as follows:

	12-in.	11-in.	10-in.	9.4-in.	8-in.	6-in.	4-in.	3.4-in.
United States	14	—	16	—	8	6	26	—
German	—	24	—	8	4	46	24	68

The Germans, therefore, had some slight preponderance in big guns and an enormous advantage in R. F. pieces. They were, however, larger targets, and this completely neutralized the R. F. advantage. More than half the German R. F. went at once; the remainder did all the harm they could do, and still left the modern monitors afloat. But for the submarines, however, Germany would have won—these turned the scale completely, and only the Brandenburg, Weissembourg, and Prinz Adalbert—all badly mauled—escaped.

This ended the "war"—it not being considered advisable to play things out further.

The net result was a draw perhaps—but a draw decidedly in favor of America, which was left with two effective battleships of the Maine class. Germany had only the Schwaben, which was not allowed ready until this stage, and the coast defense ships, unable to cross the Atlantic.

No exact record of incidental losses was attempted, but a scale of ratios and percentages was made out. By this—the scale being from 100 to 0—the losses to commerce and so forth thus appeared:

Commerce:	U. S. A.	60
	Germany	25
Coast property, etc.:	U. S. A.	40
	Germany	0

The U. S. A. also lost one base (Havana); but it was umpired that this would have to be evacuated again by the Germans or recaptured easily enough. The German attempt on another U. S. base (Manila) was, it will be remembered, a failure.

The umpires' report was to the effect that, though other strategical dispositions might have been made, those undertaken were carried through very well and (taking all circumstances into consideration) without very serious errors on either side.

The final action was not noted as a tactical error of moment, it being held that it was essential for Germany to defeat the American fleet before the arrival of the Maines. An attack on the Maines—for reasons referred to last week—was not indicated as a better move.

A spell of "fine weather" alone allowed the monitors and submarines to operate; still this was in the chapter of reasonable accidents. The Germans were sure of winning—overlooking the advantage that the monitors possessed in the way of being small targets. Finding this to be the case, the umpires suggested that, since the final battle had to be fought, the Germans would not have been wise, believing as they did, to have continued an evasive war that offered no further advantages. The limit of coast damage was reached. The cost to America was very great, but it was not an unbearable cost, nor could it increase. Thus far Germany

failed. But in so far as America was left totally unable to operate against the German coast, she, too, failed. It was assumed that, things having reached this deadlock, peace would probably ensue; or if not, that the conduct of further operations would not be of an instructive nature. No one perhaps had any clear idea as to what further operations would be; so there was readiness to accept the umpires' verdict that America would recapture Havana and probably obtain possession of Kiao-Chau. Some of the German side argued that they could with the Schwaben and repaired ships scrape together a force to insure the relief of Havana and the further destruction of American trade, but the umpires negatived the claim on the grounds that the Atlantic voyage could not be undertaken in the face of the American fleet that remained.

FINAL LESSONS OF THE GERMAN-AMERICAN WAR GAME.

(Editorial from *Scientific American* of April 4, 1903.)

PANAMA CANAL.—It will be generally agreed that the most important fact brought out by the war is the great strategical advantage which would have been conferred upon this country by the existence of the Panama Canal. It was because we had no short cut to the Pacific that the Germans, in the early stage of the conflict, were able to concentrate an overwhelming and homogeneous force of battleships at Manila, and practically wipe out the heterogeneous fleet of battleships, monitors, and cruisers which had been hastily assembled for the defense of our naval base in the Far East. In that fight we lost four battleships, two monitors, and four cruisers; and it was only after sufficient time had elapsed for us to concentrate in eastern waters the three battleships of the Maine class, together with the Alabama and Kearsarge, that we were able to stem the tide of disaster by winning a signal victory off the German base at Kiao Chau. After our success in the Pacific, there was another long delay, pending the arrival of two battleships of the Maine class from the Far East by way of Cape Horn. Had the Panama Canal been in existence, we could have concentrated a force off Havana which would have insured the early destruction of the German fleet in the West Indies; and the victory that was ultimately secured would have been more decisive than it was.

THE SUBMERGED TORPEDO TUBE.—The second lesson of the war is the enormous value of the submerged torpedo tube on battleships and cruisers. The majority of the German vessels engaged were fitted with a submerged tube located on the longitudinal axis of the vessel, at the point below water where the fore-foot rounds up into the ram. The German naval constructors were early to perceive the immense advantage of the submerged torpedo tube and all of their latest ships, both battleships and cruisers, have been so fitted. Our own vessels, unfortunately, did not carry a submerged tube, and the above-water tubes, because of the great risk of the explosion of the torpedoes by the rapid-fire guns of the enemy, had been in many cases removed, leaving our ships with at best only a very limited torpedo armament. This disparity not only seriously hampered

the American admirals in the disposition and handling of their vessels, but in some battles it proved the undoing of our fleets. In a cruiser engagement that took place in the Atlantic early in the war, the issue was suddenly decided by a swift movement of the German cruisers, which enabled them to torpedo four of our cruisers in succession, the German boats being able to cross in front of our line at sufficiently close range for using the torpedo, without being themselves exposed to torpedo attack. In the whole war we lost, by torpedoes fired from the warships themselves, no less than eight battleships and cruisers against a loss to the Germans in battleships and cruisers by torpedoes from our own ships, if we exclude the submarines, of only one cruiser.

TORPEDO BOATS AND DESTROYERS.—The torpedo boat, moreover, fully established itself as a most effective element in modern warfare. In the battle off Manila early in the war, after our fleet had been thrown into disorder, the German torpedo boats were sent in to give the final *coup de grace*, which they did by sinking three battleships and two monitors. Then again, in a night action between two approximately equal fleets of cruisers and torpedo boats (in which, because of a similar ruse adopted by each fleet, each group of torpedo boats was enabled to get in among the enemy's ships) the entire force on both sides was wiped out, every cruiser and all the torpedo boats but one being torpedoed and sent to the bottom. Extraordinary as this result appears, it was considered by the umpires that under the tactics adopted it was perfectly possible. In this conflict alone ten cruisers were sunk by torpedoes, besides a dozen or so torpedo boats.

MONITORS IN ACTION.—The war served to demonstrate once more the comparative uselessness and, under certain conditions, the absolute encumbrance of monitors, when they form a part of the line of battle. On more than one occasion the speed gage remained with the Germans because of the obligation that the American admiral was under to keep down the speed of his battleships to that of the slow monitors. This was one of the contributory causes to the defeat at Manila; and although in the last fight of the war, as described in the current issue of the *Supplement*, the monitors proved to be extremely hard to hit, and although their 12-inch guns did frightful execution upon the German battleships, it is a question whether the small target that they afforded was not more than offset by their comparative unhandiness and lack of maneuvering ability. Furthermore, it is a fact that in this battle, while the German line was moving at an uniform speed of 15 knots, our own line, because of the slowness of the monitors, was moving only at a little over 7 knots an hour, or only half as fast.

SUBMARINES.—In the great deciding battle of the war, victory was snatched from the German fleet by the sudden entrance of the submarines into the fight at the very moment when the remaining German ships were closing in, themselves badly disabled and with speed greatly reduced, for the closing stroke. This result will naturally be very pleasing to those who pin their faith to the submarine; but it must be remembered that their effective work was due to most favorable weather conditions, for

the day being particularly fine, and the sea smooth, it rendered the successful operation of the submarines possible. Moreover, these same weather conditions were distinctly favorable to the monitors, which, had the sea been rough, could never have concentrated such an effective fire as they did against the German line.

GUNNERY.—Although the American navy was conspicuously weak in torpedo attack, the greatest credit is to be accorded to its gunnery, which proved almost as destructive to the German fleets as the German torpedoes did to our own. To the concentration of fire from our heavy guns is to be attributed the loss of two German cruisers and of six of the finest of the German battleships, in our victorious action off Kiao Chau; and in the successful battle that closed the war, it was the terrific mauling received by three battleships, the Wettin, Mecklenburg, and Woerth, that rendered them easy objects of attack at the close of the battle by our submarines. As far as our own ships are concerned, we lost six cruisers and five monitors, as the direct result of gun fire, the vessels being either sunk, or so completely disabled that they were obliged to strike.

SPEED.—There can be no question that the possession by the Germans of the speed gage in certain of the conflicts of the war was of enormous advantage; and it was only when matters were evened up in this respect, in the battle won by us off Kiao Chau, a victory due largely to the good speed of the Maine, Missouri, and Ohio, that we were able to turn the tables and maneuver to good effect. If the lessons of the war teach anything, they teach the folly of building battleships or cruisers whose speed is below the average speed of any possible enemy. Eighteen knots should be the lowest contemplated speed of our future battleships; and it is quite a question whether it will not prove to be an advantage to sacrifice some weight of gun fire for the sake of an additional knot of speed. The admirals on both sides seem to have aimed at placing their line of battle in a position which would enable them to concentrate the whole fire of the fleet on the head or tail of the enemy's line, disabling his ships in detail; and such a feat is only possible to the fleet which has a higher average speed and general greater mobility.

ENORMOUS PERCENTAGE OF LOSSES.—Perhaps, after all, the most striking fact brought out by this war game is the frightful diminution of naval strength and international standing which will occur in both of the navies engaged. Out of a total of 49 ships engaged, Germany lost about a score, in which were included the very finest of her battleships; while out of the total of 53 vessels engaged on the American side, we lost no less than 29. While our loss was numerically greater, we did not lose so large a number of our best ships. The exhausted condition of the combatants at the close of the war is shown by the fact that, although the umpires decided that the advantage lay with the American navy, the mutual destruction had been so terrific that the German navy had but one effective battleship left and the United States but two; that is to say, there were in the combined fleets but three first-class battleships left at the close of the war, that were in condition to carry on the conflict. Consequently, two of the first-class navies of the world were reduced in a few months

to a second-class position as regards their fighting strength; and since the work of battleship building is slow, it would take at least four or five years to bring these navies up to their strength at the opening of the war, and probably twice that length of time to restore them to their relative standing among the other great navies of the world.

Here is a consideration which we think must make very strongly for peace in all future international controversies. When the defeat of an enemy is attained at such a frightful cost and at such peril to international ranking, we look to see the very last resources of diplomacy exhausted before any war takes place between the leading powers.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

"REPORTS OF FITNESS" IN THE CASE OF NAVAL ACADEMY GRADUATES.

By LIEUTENANT-COMDR. WM. F. FULLAM, U. S. Navy.

Criticisms, more or less caustic, are heard from time to time regarding the efficiency of newly graduated midshipmen, and many theories, not all of which will bear examination, are advanced looking to the possible improvement in the course of practical instruction at the Naval Academy.

Midshipmen who leave Annapolis nowadays are being pushed forward to positions of responsibility almost as quickly as they were in the days of the Civil War. Quite naturally they are subjected to a severe test—far more severe than in the case of graduates between 1875 and 1897.

With all due respect, the critics of the Naval Academy are rather unreasonable, as a rule. They seem to think that the Naval Academy should graduate lieutenants instead of midshipmen. If there is any naval school in the world which succeeds in doing this in four years, or if our own Naval Academy ever did it, properly speaking, there may be some reason to expect it to-day, but not otherwise. It is not such an easy matter to convert a green country boy into a watch and divisional officer in four short years, and at the same time give him a respectable academic education. For similar reasons colleges do not graduate distinguished lawyers and skilled surgeons.

Prior to the establishment of the six-years' course, the passed midshipman was not supposed to be a lieutenant, but he returned for an examination after two years at sea, before he was commissioned an ensign. Then, as now, it was held that he needed two years' practical experience afloat to supplement his

academic course. Those of us who can remember our own brilliancy as graduates may, perhaps, modestly admit that the midshipman of to-day is quite up to the standard reached by ourselves and our distinguished contemporaries. The writer can testify to the fact that the purely practical instruction of midshipmen at the Naval Academy is to-day quite as systematic, progressive, and thorough as it was thirty years ago. In fact there is reason to say that there has been a great improvement in many respects, and that a constant and watchful eye is kept upon this part of the course. The "Programme of Practical Instruction" could not be easily improved upon. The only thing that is lacking is modern and up-to-date material—guns, machinery, ships, etc.,—with which to usefully employ the midshipmen during drill periods. Such materials are not always available for use at the Naval Academy, and the officers are compelled to make the most of inadequate facilities.

In order to bring before the service a fair and complete statement regarding the efficiency of the graduate of to-day, the "Reports of Fitness" of a whole class are given below. The names of the midshipmen and of their commanding officers are omitted. The average work for the two years' cruise in each case is based upon the quarterly reports for the whole period. It will be seen that only six midshipmen out of sixty-six received less than 3.00 from their commanding officers for the cruise. Forty-five received 3.40 and above. Thirty-five received 3.50 and above.

The accompanying remarks of commanding officers also show a very high degree of efficiency, aptitude and good conduct. In cases where there was improvement or deterioration, or where a midshipman served with two or more commanding officers, who estimated him differently, more than one comment is quoted; otherwise, only a single comment is published, showing his average record for the cruise.

A close examination of these records may be said to establish the fact that the Naval Academy does its work astonishingly well. No stronger testimony from the "service" could be desired than this from the commanding officers of these young gentlemen. Many of the comments are enthusiastic and complimentary to the highest degree. *The average of all the marks of this class in "Fitness," given by commanding officers for a*

two years' cruise, is higher than that which was ever given the same class by their instructors at the Naval Academy in any branch either practical or theoretical.

To be sure, it is sometimes asserted that these marks of commanding officers are given carelessly and perfunctorily, and should not be relied upon. But this ought not to be. It is a very serious charge. Commanding officers should do their duty in developing the graduate. It is the manifest duty of the "service" to transform the midshipman into a lieutenant. The "service" should not expect the Naval Academy to graduate watch officers, navigators, and executive officers. No naval academy in the world does it. But if the "service" will only do its proper duty as well as the Naval Academy does its work, the graduate will quickly reach the standard which it is reasonable to expect of him.

Making all due allowance, however, for the so-called "perfunctoriness," or charity, shown in these marks, it is doubtful if a class ever graduated from the Naval Academy in the early days, or from any other naval school, whose reports at the end of a two-years' cruise were more creditable. It is a record to be proud of, and those officers who so fondly sing that good old song, "When *I* was a midshipman, etc.," should read this report attentively and permit their memories to carry them back to their own triumphs in cadet days. And, if their memories serve them correctly, they may be prevailed upon to admit that they themselves did not *secure*, and did not *deserve*, a better report than this. We must be fair in this matter; we must be reasonably modest. On the face of the returns from commanding officers, the Naval Academy and the graduated midshipmen do not appear to have deteriorated in recent years.

The numbers assigned to midshipmen below are not in the order of class standing, but simply serve to show that all of the sixty-six members of the class are included in the report.

1. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.60.

"Midshipman ———— has performed all the duties of a watch and divisional officer on board this vessel since June 15, 1901 (eighteen months), with ability, judgment and zeal. His conduct and bearing have been excellent."

———— Commander, U. S. N.
Commanding U. S. S. ————

"Will make a very good officer. Is now very interested and attentive to duties in engine and fire rooms; handles the engine with skill."

———— Captain U. S. N.,
Commanding U. S. S. ————

2. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.70.
"Midshipman ———— has shown aptitude for the service. He has an excellent bearing and address and has shown ability in handling enlisted men."

———— Captain U. S. N.,
Commanding U. S. S. ————

"An excellent young officer. Very intelligent, zealous, active, and successful in performing all his duties. An excellent watch and divisional officer."

———— Commander U. S. N.,
Commanding U. S. S. ————

3. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.60.
"Midshipman ————. The bearing of this officer, and his manner of performing duty are excellent in all respects. His judgment unusually good for one so young in the service, and his success in handling men leaves little to be desired. He seems thoroughly interested in his profession, and is altogether a very promising young officer."

———— Captain U. S. N.,
Commanding U. S. S. ————

"Is a good officer already."

———— Captain U. S. N.,
Commanding U. S. S. ————

4. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.40.
"Midshipman ———— is intelligent, pays strict attention to his duty, and is well qualified for promotion."

———— Captain U. S. N.,
Commanding U. S. S. ————

"Is a young officer of very high character and good promise."

———— Captain U. S. N.,
Commanding U. S. S. ————

5. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.70.
"Midshipman ————. A very good watch officer."

————Lt.-Comdr. U. S. N.,
Commanding U. S. S. ————

6. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.50.
"A very promising young officer, zealous and interested in the performance of his duties."

———— Captain U. S. N.,
Commanding U. S. S. ————

"An energetic, and painstaking officer, and one of the best men handling and sailing a boat I have met."

———— Commander U. S. N.,
Commanding U. S. S. ————

7. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.20.
"Midshipman ———— shows qualities which will tend in the future to make him an excellent officer."

———— Commander U. S. N.,
Commanding U. S. S. ————

8. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.00.
"The duty of Midshipmen on the ———— during the last nine months has been severe; they are regular watch and division officers, and the ship has been cruising constantly; Midshipman ———— has performed the numerous duties for which he has been detailed, very satisfactorily."

————Commander U. S. N.
Commanding U. S. S. ————

9. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.20.
"The duties were varied and irregular according to emergency demands during summer work. The duties varied from running the engines of a steam launch to having charge of a turret division and from being Asst. Navigator to being a regular watch officer in port. All work was very good to excellent."

———— Captain U. S. N.,
Commanding U. S. S. ————

10. Midshipman ————
Average of marks, "Report on Fitness," for the cruise, 3.20.
"I regard Mr. ———— as a very promising young officer."

———— Captain U. S. N.,
Commanding U. S. S. ————

11. Midshipman ————
Average marks, "Reports on Fitness," for the cruise, 3.60.
"As stated before Mr. ———— has performed the duties devolving upon him with marked ability. He has been of the greatest assist-

ance to me in placing the vessel in commission, stationing the crew, taking up the stores, and in general getting this vessel in cruising conditions."

———— Lieutenant U. S. N.,
Commanding U. S. S. ————

12. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.40.

"Did all kinds of duties, from running the engines of a steam launch to deck duties at irregular periods during the manœuvres and after."

———— Captain U. S. N.,
Commanding U. S. S. ————

"Appears to be very nervous and unable to look after more than one thing at a time. However, this may disappear with age and more experience."

———— Captain U. S. N.,
Commanding U. S. S. ————

13. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.70.

"Mr. ———— possesses natural qualifications for an excellent officer. His address and bearing are excellent. He has led in athletics amongst the crew, and is conspicuous for his ability to handle enlisted men."

———— Captain U. S. N.,
Commanding U. S. S. ————

14. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.20.

"An officer of excellent bearing, faithful in the performance of his duties. Owing to changes in senior officers, the charge of the Powder Division was assigned to him for the greater part of the quarter, which position he filled with marked ability. He is well qualified for advancement."

———— Captain U. S. N.,
Commanding U. S. S. ————

"Average ability, zeal and intelligence. Improving with experience."

———— Lt.-Comdr. U. S. N.,
Commanding U. S. S. ————

15. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.40.

"Has shown marked improvement, and I believe will make a very good officer, although a little slow."

———— Captain U. S. N.,
Commanding U. S. S. ————

16. Midshipman ————————
Average of marks, "Reports on Fitness," for the cruise, 3.60.
"An officer of great promise. I have the utmost confidence in him, and would be glad to have him as one of the regular watch and division officers of the ship."

———————— Captain U. S. N.,
Commanding U. S. S. ————————

17. Midshipman ————————
Average of marks, "Reports on Fitness," for the cruise, 3.40.
"Mr. ———————— is a promising officer.

———————— Captain U. S. N.,
Commanding U. S. S. ————————

18. Midshipman ————————
Average of marks, "Reports on Fitness," for the cruise, 3.50.
"Midshipman ———————— is improving slowly; he is beginning to give orders, and the effect of total suppression is slowly wearing away. He lacks individuality at present. He is zealous and painstaking."

———————— Captain U. S. N.,
Commanding U. S. S. ————————

"An excellent officer in every way yet tried."

———————— Captain U. S. N.,
Commanding U. S. S. ————————

19. Midshipman ————————
Average of marks, "Reports on Fitness," for the cruise, 3.60.
"Mr. ———————— has a very good bearing and address. He has been attentive to his duties and has availed himself of his opportunities for perfecting himself in his profession."

———————— Captain U. S. N.,
Commanding U. S. S. ————————

"Midshipman ———————— has good control, is cool and steady on duty, which qualities seem to point fair to an early development of his naval usefulness."

———————— Commander U. S. N.,
Commanding U. S. S. ————————

20. Midshipman ————————
Average of marks, "Reports on Fitness," for the cruise, 3.40.
"This officer is unusually bright. Has a fine intellect. Is good at anything. In the engine-room he is so efficient that he had charge of the watch regularly at sea during the month of his detail in this department. He is very satisfactory in all respects. I consider him mentally the first of the five midshipmen in the ship."

———————— Captain U. S. N.,
Commanding U. S. S. ————————

21. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.70.

"Mr. ———— has shown himself to be possessed of the qualities of tact and judgment in handling men, fertility of resource, and ability that should make him a first-class deck and division officer. I should be very glad if he could be left in that capacity on board this ship."

———— Captain U. S. N.,
Commanding U. S. S. ————

22. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.20.

"Mr. ———— is not very fond of work and is rather trifling. These faults may arise from youthfulness."

———— Captain U. S. N.,
Commanding U. S. S. ————

23. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.40.

"His bearing and address are good. He has been attentive to his duty, and has availed himself of his opportunities for perfecting himself in his profession. He has been a leader in athletics amongst the crew."

———— Captain U. S. N.,
Commanding U. S. S. ————

24. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.70.

"As I have before reported, this midshipman has remarkable poise, judgment and grasp for a man out of the Academy so lately. Perhaps I can best express my estimate of his character and attainments by saying that I would like to have him to-morrow, as a watch officer, or as navigator, in any ship I could command."

———— Commander U. S. N.,
Commanding U. S. S. ————

25. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.70.

"Mr. ———— shows more than ordinary ability in handling men. He will do very well in the service."

———— Captain U. S. N.,
Commanding U. S. S. ————

"Mr. ———— gives promise of great usefulness in the service—especially as a sea officer."

———— Captain U. S. N.,
Commanding U. S. S. ————

"A very intelligent and zealous officer."

————Commander U. S. N.,
Commanding U. S. S. ————

26. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.60.

"Mr. ———— is cool, quiet, and deliberate in his manner of performing duty. I believe he will make an excellent officer."

———— Captain U. S. N.,
Commanding U. S. S. ————

27. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.20.

"The duties of midshipmen on board the ———— during the last quarter have been very severe; they are regular watch and division officers, and the ship has been cruising constantly; Midshipman ———— has performed these numerous duties very satisfactorily."

————Commander U. S. N.,
Commanding U. S. S. ————

28. Midshipman ————

Average of marks, "Report on Fitness," for the cruise, 3.60.

"Mr. ———— has had full charge of the care and instruction of a division of sixty recruits, and in consideration of this duty I have not required him to write a full journal. This form gives no emphasis to reliability, which I consider one of the strongest features of Mr. ————'s character."

————Commander U. S. N.,
Commanding U. S. S. ————

"Mr. ———— has performed the duties of regular watch officer very acceptably. He is a good drill officer, and his navigation work shows marked improvement."

————Commander U. S. N.,
Commanding U. S. S. ————

29. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.50.

"I consider it but fair to state that Mr. ———— is one of three watch and division officers on this ship. The routine of the ship keeps him continually employed, and leaves but a few hours for exercise ashore and study. The above has been continuous during my command. Again, he has had but four days at sea since he joined."

———— Commander U. S. N.,
Commanding U. S. S. ————

30. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.60.

"Midshipman ———— has performed the duties of Executive and Engineer Officer, and has, in addition to these duties, stood a watch on deck. His performance ranks from very good to excellent in all ex-

cept Engineering in which branch he was handicapped in the beginning by a total lack of experience; but he has shown marked improvement."

———— Lieutenant U. S. N.,
Commanding U. S. S. ————

"A very good officer."

———— Captain U. S. N.,
Commanding U. S. S. ————

31. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.60.

"This is a very promising young officer. He manifests interest and zeal in the performance of his duties, and is constantly improving."

———— Captain U. S. N.,
Commanding U. S. S. ————

"A bright self-reliant and promising young officer."

———— Lieut-Commander U. S. N.,
Commanding U. S. S. ————

32. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.50.

"Midshipman ———— is a zealous, efficient officer, of excellent bearing and character. He has performed his duties as a watch and division officer on board this ship to my entire satisfaction, and I commend him to the consideration of his examining Board."

———— Commander U. S. N.,
Commanding U. S. S. ————

33. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.60.

"Midshipman ———— has performed all of his duties in a zealous, painstaking, and conscientious manner, and I consider him a young officer of marked ability, and a credit to the naval service."

———— Commander U. S. N.,
Commanding U. S. S. ————

"This is a very promising young officer."

———— Captain U. S. N.,
Commanding U. S. S. ————

34. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.70.

"During an emergency caused by the bursting of boiler tubes, Mr. ———— rendered voluntary and efficient service. I think he will make a fine officer."

———— Captain U. S. N.,
Commanding U. S. S. ————

"Mr. ———— gives promise of being in all ways an excellent officer."

———— Commander U. S. N.,
Commanding U. S. S. ————

35. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 2.70.

"This young officer is very zealous and energetic, but seems to be lacking in mental calibre. He has been informed of the unfavorable replies to number 1-i and number 2-a, and did not desire to submit any statement in reply."

———— Captain U. S. N.,
Commanding U. S. S. ————

"Will make an excellent officer."

———— Commander U. S. N.,
Commanding U. S. S. ————

36. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 2.80.

"Did all kinds of duties from running the engines of a steam launch to deck duties at irregular periods during the manœuvres and after."

———— Captain U. S. N.,
Commanding U. S. S. ————

"Mr. ———— lacks zeal and industry and is apt to be led astray ashore. He has sufficient ability when he desires to show it."

———— Commander U. S. N.,
Commanding U. S. S. ————

37. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.60.

"Mr. ————'s bearing and address are good. He has been attentive to his duties, and has availed himself of his opportunities for perfecting himself in his profession."

———— Captain U. S. N.,
Commanding U. S. S. ————

38. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.50.

"Mr. ———— has shown aptitude for the service. He has a good bearing and address, and he has availed himself of his opportunities for perfecting himself in the practical knowledge of his profession."

———— Captain U. S. N.,
Commanding U. S. S. ————

39. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.70.
"Displayed marked ability in all the duties assigned him, performing them in an unusually, zealous and eminently satisfactory manner."
———— Lieutenant U. S. N.,
Commanding U. S. T. B.————

40. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.50.
"A very good officer and exceptionally qualified for any scientific specialty.
———— Captain U. S. N.,
Commanding U. S. S. ————

41. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.50.
"A very good watch officer, also Engineer. An excellent practical man, full of resources. Very reliable."
———— Lieut.-Comdr. U. S. N.,
Commanding U. S. S. ————

"With considerable more snap and energy Midshipman ———— would make an excellent officer. He lacks these attributes."
———— Lieut.-Comdr. U. S. N.,
Commanding U. S. S. ————

42. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.80.
"An excellent officer in knowledge of his duties, in the manner of performing his duty, and in bearing."
———— Commander U. S. N.,
Commanding U. S. S. ————

"An excellent officer, and has an aptitude for handling enlisted men."
———— Captain U. S. N.,
Commanding U. S. S. ————

43. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.40.
"Mr. ———— in my opinion, gives promise of making a valuable officer. He is attentive to duty and is very capable."
———— Captain U. S. N.,
Commanding U. S. S. ————

"An officer of intelligence and ability. Has a talent for drawing. He is careful and faithful in performing his duties. Will make an accomplished officer. I recommend him for advancement.
———— Captain U. S. N.,
Commanding U. S. S. ————

44. Midshipman ————————
Average of marks, "Reports on Fitness," for the cruise, 3.40.
"Mr. ———— is a fine appearing young gentleman and performs his duties satisfactorily. He has fair ability. He is correct in his habits, and always cheerful. I consider him well deserving of promotion. He has done well in the engine room. Is acquiring a full knowledge of the Spanish language."

———— Captain U. S. N.,
Commanding U. S. S. ————

45. Midshipman ————————
Average of marks, "Reports on Fitness," for the cruise, 2.80.
"Mr. ———— must improve materially in attention to duty, and in his sense of responsibility if he wishes to become of value to the naval service."

———— Commander U. S. N.,
Commanding U. S. S. ————

"Great improvement since previous report. This young gentleman has quite enough intelligence to be a useful officer if he attends to his duties."

———— Commander U. S. N.,
Commanding U. S. S. ————

46. Midshipman ————————
Average of marks, "Reports on Fitness," for the cruise, 3.50.
"A very promising young officer, unusually so. He is zealous and interested in the performance of his duties, and does everthing very satisfactorily."

———— Captain U. S. N.,
Commanding U. S. S. ————

47. Midshipman ————————
Average of marks, "Reports on Fitness," for the cruise, 2.70.
"Mr. ———— carries on his duties well, and is qualified for promotion."

———— Captain U. S. N.,
Commanding U. S. S. ————

"Is intelligent, energetic and will do well in the service."

———— Captain U. S. N.,
Commanding U. S. S. ————

48. Midshipman ————————
Average marks, "Report on Fitness," for the cruise, 3.50.
"Mr. ———— is an earnest, honest, and intelligent officer, with abundant force of character but very little force of manner in carrying out his duties."

———— Lieut.-Commander U. S. S.
Commanding U. S. S. ————

"A zealous conscientious officer."

———— Commander U. S. N.,
Commanding U. S. S. ————

49. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 2.80.
"As officer of the deck, his mind seems to be wandering far from his duties; has little energy."

———— Commander U. S. N.,
Commanding U. S. S. ————

50. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.50.
"Shows marked aptitude for the service. An officer of fine appearance. Faithful in the performance of his duties. I recommend him for advancement."

———— Captain U. S. N.,
Commanding U. S. S. ————

51. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.60.
"This is an officer of fine bearing and marked aptitude for the service. He takes great interest in athletics, and exercises a good influence over those about him; his conduct is excellent. He will make a fine officer."

———— Captain U. S. N.,
Commanding U. S. S. ————

52. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.80.
"Mr. ———— is an excellent officer. He has shown himself competent to have charge of the ship in squadron, under way, and during manœuvres both by night and day. Qualified in A, B, and C and in small arms requirement of 'D' Gunnery Instructions."

———— Captain U. S. N.,
Commanding U. S. S. ————

"Mr. ———— is an industrious, painstaking, vigilant and capable officer."

———— Captain U. S. N.,
Commanding U. S. S. ————

53. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.70.
"I think that Mr. ———— will make an excellent officer. He is a conscientious, intelligent, and thorough young man."

———— Captain U. S. N.,
Commanding U. S. S. ————

"Mr. ———— has had charge of the engines for the past year, though not excused from watch and survey duty. He has been diligent and attentive, and he is a thoroughly subordinate and faithful officer."

———— Commander U. S. N.,
Commanding U. S. S. ————

54. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.20.

"Will make a good officer. Is now very interested and attentive to duties in engine, and fire rooms, handles the engines with skill."

———— Captain U. S. N.,
Commanding U. S. S. ————

"Deck duty performed at N. Y. Yard alongside wharf very difficult and trying for an inexperienced officer on a battle and flag ship. No regular watch officer to advise him."

———— Captain U. S. N.,
Commanding U. S. S. ————

55. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.60.

"Mr. ———— shows zeal, intelligence, and a conscientious desire to do his duty, and I think him a promising young officer. He is amenable to advice and instruction; very gentlemanly in his conduct, and shows the benefit of the experience which he is gaining in important duties."

———— Commander U S. N.,
Commanding U. S. S. ————

56. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.20.

"An excellent officer and has the gift of handling enlisted men."

———— Captain U. S. N.,
Commanding U. S. S. ————

"Is capable of standing deck watch under all ordinary circumstances."

———— Captain U. S. N.,
Commanding U. S. S. ————

57. Midshipman ————

Average of marks, "Reports on Fitness," for the cruise, 3.40.

"Has capacity, mental and physical, and needs but energy to make him a most reliable officer."

———— Captain U. S. N.,
Commanding U. S. S. ————

58. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.00.
A very competent, conscientious, painstaking officer, only lacking in 'snap.'"

———— Lt.-Comdr. U. S. N.,
Commanding U. S. S. ————

59. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 2.70.
"This officer lacks decision and force, and seems lethargic in performance of his duties."

———— Commander U. S. N.,
Commanding U. S. S. ————

60. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.80.
"This is a most promising officer. He is thoroughly efficient and capable. Careful and attentive in all that he has to do. An all around man. Satisfactory on decks, in the engine room, and in athletics. Withal, a fine presence and a gentleman."

———— Captain U. S. N.,
Commanding U. S. S. ————

"I write in the highest praise of this admirable officer. He is perfectly equipped and balanced to make a naval officer of the very best class. He is industrious, thorough, cheerful; has tact and all the qualities that go to make a successful officer. Withal, he is modest, and his disposition is faultless. I commend him to the academic board as one most worthy of its consideration."

———— Captain U. S. N.,
Commanding U. S. S. ————

61. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.60.
"Intelligent, zealous, and reliable. Will probably develop into an excellent and valuable officer."

———— Commander U. S. N.,
Commanding U. S. S. ————

"As a second on a small gun-boat, he has been called on to perform various duties which he has complied with in a very satisfactory manner."

———— Lieutenant U. S. N.,
Commanding U. S. S. ————

62. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.40.
"This officer, though just from the Naval Academy, performs his duty in a most satisfactory manner."

———— Captain U. S. N.,
Commanding U. S. S. ————

"Will improve with experience and occasional caution to spur him on to increased action. Has plenty of ability and talent."

———— Commander U. S. N.,
Commanding U. S. S. ————

63. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.00.
"Mr. ———— has performed his duties generally in a satisfactory manner. He will probably make an average officer. His faults are those of the young officer, but they are somewhat exaggerated in the matter of observation. Is almost lacking in this important quality."

———— Lieutenant U. S. N.,
Commanding U. S. S. ————

"Will make an excellent officer."

———— Captain U. S. N.,
Commanding U. S. S. ————

64. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.20.
"This officer performs any designated duty very satisfactorily, though with a somewhat lackadaisical manner, indicative of a certain indifference and laziness. I believe this to be due largely, if not entirely to the peculiarly monotonous and uneventful duty this vessel has been performing.
"A certain familiar and yet 'nagging' manner towards enlisted men makes his handling of them not entirely satisfactory."

Leut.-Comdr. U. S. N.,
Commanding U. S. S. ————

65. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.70.
"Mr. ———— is already a capable officer, of mature judgment and well balanced character. His duties in connection with the survey carried on by the ———— have developed capacity for independent action and for accurate observation. He is fit to be entrusted with responsibilities."

———— Commander U. S. N.,
Commanding U. S. S. ————

"Mr. ———— is an exceptionally cool, judicious, and efficient officer. His judgment is remarkably mature for one of his age and experience."

Lieut.-Comdr. U. S. N.,
Commanding U. S. S. ————

66. Midshipman ————
Average of marks, "Reports on Fitness," for the cruise, 3.50.
"Mr. ———— has improved in his manner of performing duty. Experience in charge of the deck has given him confidence in himself.

He is careful and ever anxious to learn and to improve himself professionally. He is naturally a thinker and is sensitive, which makes him a bit slow; but he is cool-headed, and I believe that experience will develop in him a good officer."

———— Commander U. S. N.,
Commanding U. S. S. ————

"Has most charming manners; will make a polished and very good officer."

———— Captain U. S. N.,
Commanding U. S. F. S. ————

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE FISKE SEMAPHORE SYSTEM.

By COMMANDER BRADLEY A. FISKE, U. S. N.

This system, after undergoing trial in service in the Kearsarge and Alabama for two years and four months, was finally approved; and sets were ordered to be installed in the Illinois, Massachusetts, Maine, Iowa and Indiana, on April 1, 1903. It was invented by the writer many years ago. But the navy, as it then was, was so contented with flag signals, that he did not think it wise to present an absolute apparatus for test, until 1896, when he had an apparatus made and installed in the U. S. S. New York, then flagship of the North Atlantic Squadron. He was immediately sent to Asia.

The semaphore apparatus in the New York was, like the Ardois, operated from an electric keyboard; and, after working very well for a few months, it got out of order from an easily reparable derangement,—the burning out of a solenoid that moved one of the semaphore arms. Shortly afterwards, it was put out of the ship, and progress in naval signalling was set back six years.

In 1900, on his return from his cruise in Asia, the writer succeeded, after much difficulty, in getting another apparatus constructed; and, finally, after numerous trials of this apparatus, conducted on shore and lasting several months, he succeeded in getting apparatus installed in the U. S. S. Alabama and U. S. S. Kearsarge. In deference to the prejudice against electrical apparatus, and in accordance with the advice of all the officers to whom the writer spoke on the subject, these apparatus were made to work by hand power instead of by electric power. They do not work nearly so quickly as electric apparatus, and

are fully as apt to get out of order, and the signalmen are left exposed to be shot down in action. Still, they work very well, and are better than anything else now used for signalling. The apparatus in the Alabama and Kearsarge have been operating under all conditions of weather and climate; and experience has shown that they keep in order, if given as much care as an equal surface of paintwork usually gets; and that they furnish a means of communicating among the vessels of a large fleet that can be used in the heaviest gales, and read in all directions.

Description.

Briefly described, the present apparatus consists of semaphore arms on the mast, a controller on the deck, and connecting ropes between the semaphore arms and the controller.

There are four pairs of semaphore arms shown in Fig. 1, which are placed one below the other on the mast. The office of these arms is identical with the office of the lamps of the Ardois system, and they are read from top to bottom as the Ardois lights are. If an arm is placed horizontally, it means the same as the white light of the Ardois, that is, 2. If it is placed at an angle of 45°, it means the same as the red light of the Ardois, that is, 1. If it is lined up and down the mast, it means the same as an Ardois lamp whose light is extinguished.

In order that the signals shall be readable in all directions, as is essential in signalling among ships that bear in all directions, each semaphore arm has a mate, and the two arms of the pair are placed alongside of each other on the mast, and revolve in vertical planes that are perpendicular to each other; so that, if any arm is placed say, in a horizontal position, its mate, also, goes to a horizontal position; and no matter from what direction the arms be viewed, they are seen to be horizontal and to mean 2. Similarly, if an arm is placed at an angle of 45° to the mast, its mate goes to an angle of 45°; and no matter from what direction the arms be observed, it can be seen that they are "cockbilled" and mean 1.

In constructing the first apparatus in 1896, the arms were pivoted as semaphore arms always have been, at the upper end. Fearing lest the pressure of the wind in a gale might bind the semaphore arms on the pivots, the writer imitated the pressure of the wind on the arm, by means of a weight going over a

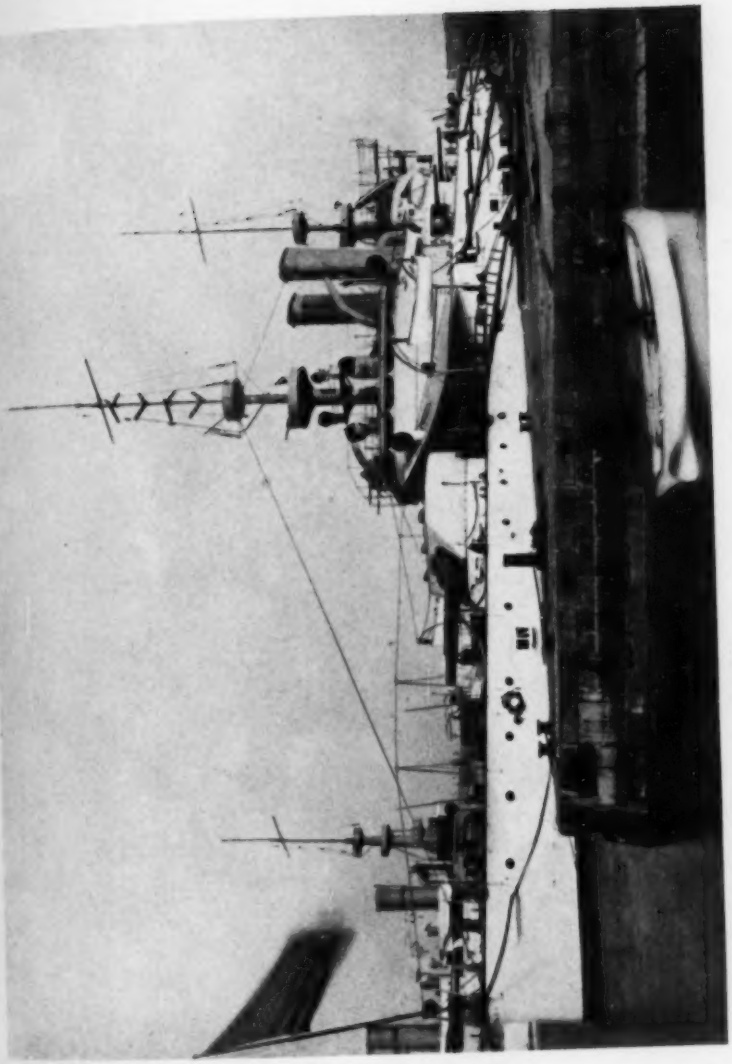

FIG. 1.

FIG. 2.

FISKE SEMAPHORE SIGNALS.

pulley, and found, to his dismay, that it bound the arm so tightly that it was impossible to move the arm with the quickness necessary. This was a crushing blow; and he almost determined to abandon the whole attempt, when the happy thought occurred to him of pivoting the arms in the middle, so that the wind pressure would balance on both sides of the pivot. It took a very short time to rig up a semaphore arm in this way, and it was then found that no matter what reasonable pressure was applied, the semaphore arm moved with perfect ease and quickness. And it is an interesting illustration of the not at all well-recognized fact that practice will always confirm theory, provided the theory be correct, that the results of this crude experiment have been confirmed in many gales of wind through which the semaphore apparatus in the New York, Alabama and Kearsarge have passed. It does not make the slightest difference whether there is a calm or a raging gale; the semaphore works exactly the same in both, and yet the arms weigh only 15 pounds each.

When the North Atlantic Fleet was anchored off Galveston in the latter part of February, 1903, the weather was so bad most of the time that flag signalling and wig-wag signalling were nearly impossible. The result was that the semaphore apparatus in the Kearsarge was used almost continually during the day, sending messages at the rate of about ten letters per minute.

The controller shown in Fig. 2, consists of a rectangular box, in which are four sliding bars, whose upper ends are connected to four wire ropes that go aloft to the four pairs of semaphore arms. If any one of the sliding bars be pulled down, therefore, it will pull around the semaphore arm connected to it. If it is pulled down all the way, it will turn the semaphore arm around through 90°, so that it will lie horizontally, and indicate 2; whereas if the sliding bar is pulled down half way, it will pull the semaphore arm half way round, and thus place it at an angle of 45° to the mast, and indicate 1. If the letter "K" is to be signalled, for instance, requiring that the upper arm signal 2, the second arm 1, the third arm 2, and the fourth arm 1, as shown in Fig. 1, the four sliding rods must be pulled down in such a way that the first rod will go down all the way, the second half way, the third all the way, and the fourth half the way. The problem, therefore, is, first, to provide a means for

pulling down the rods; and second, to control this means so that each rod will be pulled down the proper amount to signal the letter intended.

In an article like this, it is not perhaps desirable to go too much into detail; and so it may suffice to say that the power to pull down the rods is given by a lever which is pushed down by the operator; and that a pointer moving over a dial, shown in Fig. 3, being turned to the letter "K," for instance, causes

FIG. 3.

such mechanical contacts with projections inside the controller, that the lever is so connected to the four sliding rods, that, when the lever is shoved down, it pulls down the first rod all the way, the second rod half way, the third rod all the way, and the fourth rod half the way. When the lever is let go, retractile springs on the pivots of the semaphore arms turn the semaphore arms back to the up and down position, and carry up the sliding rods of the controller at the same time. Everything is now ready for making the next display. If "E" is to be the next letter signalled, the pointer on the dial is turned to "E," and the lever pushed down as before. This carries the first rod down half way, and the second rod all the way; thereby placing the top pair

of semaphore arms at an angle of 45° to the mast, and the second pair at an angle of 90° to the mast.

In practice, it has been found a good plan to turn the pointer to the letter next to be signalled, *while the lever is down, and during the time that a letter is being displayed aloft.* The reason for this is that a certain time is needed for moving the pointer exactly to the next letter; and advantage is taken of this interval of time to keep the signal displayed aloft a sufficient length of time to make it easily read. After the pointer has been set at the letter next to be signalled, the lever is raised, and at once pushed down again, displaying aloft the new signal; so that there is very little interval between two displays; but each display lasts long enough to insure its being read.

Letters.

Up to the present time, the only use that has been made of this system of signalling has been to send "Letters." It is perhaps true that, as many officers have suggested, we do not need a system for signalling "Letters" so much as we need a system for sending Battle Signals. Now this Semaphore System is especially adapted for sending Battle Signals; but I wish to pause here for a moment to say that I am absolutely sure in my own mind that there is almost as much need for a system for sending "Letters," among a large fleet. It am aware that the present flag signals and wig-wags are sufficient for the needs of a small squadron, in peace, in good weather; but let any one's imagination soar to the extent of seeing in his mind's eye, two large hostile fleets, operating in each other's vicinity; and let him imagine the information brought in by scouts; let him imagine the sudden changes of situation that may take place, so that new instructions must be sent out by the Admiral, and, maybe, entire plans of operations changed or modified, perhaps in bad weather; and he must become convinced that the times will be frequent, and the necessity urgent, for sending out orders, for giving information, and for modifying instructions, to do which would be impossible by wig-wag flags, or by means of any signals that can be printed in any Signal Book. And any officer of experience can surely call to mind many occasions on which a large number of ships have been gathered together, when the sending of information, instructions, and orders has been de-

layed until nightfall, so that the Ardois could be used, because the usual wig-wags and flags were inadequate. The writer remembers many times in Manila Bay, when Admiral Dewey did this; and he also remembers many times in the North Atlantic Fleet, during the last few months, especially in bad weather, when Admiral Higginson used the semaphore to send long communications, often more than thirty words, when flag signalling, either by wig-wag or by the telegraph code, would have been impracticable, and the sending of boats with dispatches dangerous, if not impossible. For doing work of this kind, the semaphore system can be relied on to send messages at the rate of ten letters per minute. If it were electrically controlled, this speed could be doubled.

As illustrating the convenience of this system in sending "Letters" in all directions, I remember one day in the North Atlantic Squadron, when we were engaged in manœuvres. The squadron at this time consisted of eight battleships, (if the Olympia can be called a battleship), with the flagship Kearsarge leading. Admiral Higginson began making a "Letters" signal of considerable importance; and when it was about one-quarter done, he began a countermarch to the right. The other ships in the column followed, and the message was not completed until all had finished the countermarch. The consequence was that every ship began reading the signal when she was astern of the flagship, and finished it when she was again astern; but, in the meantime, she had been on the starboard quarter of the flagship, on the starboard beam, on the starboard bow, on the starboard beam, and then on the starboard quarter; and yet the sending and reading of the message had not been disturbed or delayed in the slightest. The speed of signalling was eleven letters per minute. It does not need much imagination to see that ability to do a thing like this may, some day, be of incalculable value at a critical time, in the presence of the enemy.

The question of signalling "Letters" over long distances reminds me that in reading the lecture of Lieutenant-Commander Niblack, published in the PROCEEDINGS for September, 1902, and the subsequent discussion published in the PROCEEDINGS for December, 1902, I noticed that there was a broad difference of statement in regard to the working of the British semaphore, in the sense that some officers spoke of it as very rapid, and others as very slow.

Perhaps I may be permitted to say that I have found the same difference in the statements of officers with whom I have talked, and to point out that the difference is caused by the fact that those officers who speak of the British semaphore as fast, refer to the little apparatus which is placed on the bridges of many British warships, and which is used for signalling over short distances only; while those who speak of the British semaphore as slow, refer to the very heavy apparatus which is placed at the masthead of some large British warships, and which is used for signalling over long distances. The short-distance British semaphore is fast, for the reason that the parts are light and small; the long-distance British semaphore is slow for the reason that the parts have to be strong and heavy, and have to be moved by strong and heavy mechanism, since the arms are pivoted at one end, and the pressure of the wind binds them on their pivots.

Naturally, I think the four-arm semaphore better than the British, or I would not have invented it; for I knew all about the British semaphore before I invented the four-arm semaphore. My ideal when starting to design a day-signal-system was a day-signal *that could be read in all directions, at every instant.* That was the thing I aimed at. In working my way along, I found that some form of *semaphore* was the most practical device. I then hit on the idea of making the semaphore arms in pairs that should move in planes perpendicular to each other, so as to show in all directions. Then I made four pairs of arms, so that the day system would be like the electric night system.

I think the relative advantages of the British and the four-arm semaphores are fairly shown in the table on p. 686.

An important point of advantage of the four-arm semaphore is that, *even if the entire apparatus be deranged or shot away except one pair of arms and the line going from them to the deck, signals of all kinds can nevertheless be made, by simply wig-wagging on that line.* In fact, the signalling that can be done in this way is so good, that I have sometimes, in moments of discouragement, seriously considered the idea of abandoning all the apparatus, except the top pair of arms and the line going from them to the deck.

RELATIVE ADVANTAGES OF BRITISH AND "4-ARM" SEMAPHORE SYSTEMS.

Points of comparison.	System having the advantage.	Remarks.
Speed of signalling.	4-Arm.	Very important.
Simplicity of construction.	British.	Very important, but neither system is complicated.
Distance of readability.	?	Difference slight, since either can be read 10 miles or more.
Directions in which can be read any instant.	4-Arm.	Of commanding importance, since at a critical time it may be necessary to signal to ships bearing in various directions.
Freedom from obscuration by smoke.	British.	Difference slight, because smoke obscures either only when it is trailing aft and rising to a certain height, and because 15 feet additional height will equalize obscuration.
Freedom from influence of weather.	4-Arm.	Difference slight, neither is affected much by weather.
Ease of working.	4-Arm.	Not very important.
Freedom from derangement.	?	Very important, but neither is liable to derangement, unless neglected very much.
Freedom from mistakes in sending.	4-Arm.	Difference slight.
Freedom from mistakes in reading.	4-Arm.	Difference slight, if British semaphore is read from a favorable direction.
Adaptability to present U. S. systems of signalling.	4-Arm.	Very important.
Lightness.	4-Arm.	Not important, except in small ships.
Variety of ways in which can be used.	4-Arm.	Extremely important. At a critical time it may be necessary to send a General Signal, a Battle Signal, or "Letters" to distant ships, or shore stations.

Battle Signals and Tactical Signals.

(one-display signals and three-display signals.)

This Semaphore System can be used not only for "Letters," but for Battle Signals and for Tactical Signals also. To do this is not at all difficult. It is merely necessary to print a new Signal Book, which shall be distinctly a "Battle and Tactical Signal Book," and which shall be confidential; leaving to another General Signal Book the ordinary routine signals required in a fleet; and this book need not be confidential, but may be left about decks as much as convenient. In the "Battle and Tactical Signal Book," there can be twenty-six Battle Signals, each of

which is made by a display of a single letter, such as "A"; and there can be in addition twenty-six multiplied by twenty-six = 676 Tactical Signals, which can be made by 3 displays. To indicate that a 3-display signal (a Tactical Signal) is to be made, let "Cornet" precede all tactical signals. This can easily be done, because "Cornet," as at present used, is entirely unnecessary, and merely takes up time. This will make a total of seven hundred and two (702) Battle and Tactical Signals.

The first page might begin:

A = Open fire (Battle Signal).
Cornet A A = Course North.
Cornet A B = Course N. ¼ E.
Cornet A C = Course N. ½ E.
Cornet A D = Course N. ¾ E.
&c., &c., &c.
Cornet A Z = Course E. N. E. ¼ E.

The second page might begin:

B = Charge (Battle Signal).
Cornet B A = Course E. N. E. ½ E.
Cornet B B = Course E. N. E. ¾ E.
&c., &c., &c.
Cornet B Z = Course S. E. ¾ S.

The third page might begin:

C = Head of column Right (Battle Signal).
Cornet C A = Course S. E. by S.
Cornet C B = Course S. S. E. ¼ E.
Cornet C C = Course S. S. E. ½ E.
&c., &c., &c.

The sixth page might begin:

F = Ships left (Battle Signal).
Cornet F A = Form line of bearing, guide ship bearing North.
Cornet F B = Form line of bearing, guide ship bearing N. ¼ E.
&c., &c., &c.

The tenth page might begin:

J = Ships right about (Battle Signal).
Cornet J A = Course and line of bearing North.
Cornet J B = Course and line of bearing N. ¼ E.
&c., &c., &c.

In this book each page would be headed by a Battle Signal, needing only one display. The twenty-six Battle Signals can also be printed on small cards, for convenient use.

The use of this Battle and Tactical Signal Book, in connection with the Semaphore System, would make the handling of a large fleet in the presence of the enemy, very speedy and convenient. Suppose, for instance, that some sudden emergency made it desirable for the head of the column to go to the right, and suppose that in the Battle and Tactical Signal Book the letter "C" was the signal required. It would simply be necessary to make the letter "C," and to wait until it was repeated by each ship, and then to make the signal of execution by dropping the semaphore arms. To make the letter "C" would not require more than six seconds; the time required for all the ships to repeat it would not require more than ten seconds more, unless some of the ships were so distant, or the light so hazy, that a greater length of time was required to read it. Sixteen seconds, then, ought to be a reasonable time for making *and repeating* a Battle Signal under ordinary conditions. Half of this time would be taken up by the "repeating"; but certainly no naval officer can begrudge the time required to do this, especially when he has seen the narrow escapes that have been made even in squadron manœuvres from the misunderstanding of a flag signal; and more especially, when he contemplates the enormous disaster that would result in a swiftly moving naval battle, from the misunderstanding, even by one ship, of a Battle Signal.

It may be objected that, if any letter were sent that happened to be a ship's "Call Letter," one could not tell whether a Battle Signal, or a "Call Letter" were intended. To avoid this confusion, it would simply be necessary to order that all signals, *except* Battle Signals, should be preceded by some display. For instance, that a ship's "Call Letter" should be preceded by the display "Ship's Number"; and that "Letters," "Numbers," etc., etc., should be preceded by the displays indicating them. Therefore if any letter is made which is *not* preceded by any designating display, the reader at once knows that a Battle Signal is intended.

Suppose that, under conditions above cited, it had become desirable to make some Tactical Signal needing, three displays, say "Course and line of bearing, north ¼ east"; and suppose that Cornet, "J B" were the signal required to do this. Cornet is first

made *and repeated*, requiring sixteen seconds; "J" is then made *and repeated*, requiring sixteen seconds more; then B is made *and repeated*, requiring sixteen seconds more, or forty-eight seconds in all. This means that for any Tactical Signal whatever, forty-eight seconds would be the outside limit of time required, under ordinary conditions. If the apparatus were worked by electricity, this time could easily be divided by two.

It may be objected that if the signal Cornet "J B," for instance, were made, there would be chance for error, in the sense that when "B" was signalled, the reader might forget what letter had been signalled before. This possibility may be granted for sake of argument; but it may be pointed out that all written and spoken language is open to the same objection; and it may be suggested that it would be perfectly practicable, (though not at all necessary), to add a simple typewriter to the transmitter; so that when any signal is made, or received, the letter signalled, or received, will be automatically printed.

Flexibility.

In order to carry out this plan of Battle and Tactical Signals, in co-operation with the Semaphore System, it would be extremely desirable to have alphabetical flags, such as have frequently been suggested, to be used in case the semaphore apparatus is shot away. This brings to the front one pre-eminent advantage of the plan, which is its flexibility; its adaptability to sending signals in many different ways. For instance, the signal "J" can be sent, not only by the semaphore in the manner just described, but also by hoisting the alphabetical flag, "J"; by wig-wagging "J" with any arm of the semaphore; by using a wig-wag flag; by using a lantern and shutter; by wireless telegraphy; by pulsating one of the Ardois lamps, or the truck light, and even by the steam whistle. It is merely necessary to make the letter "J," by any of these means, *or by any other means*, and the thing is done.

General Signals.

(four-display signals.)

A four-display system would add $26 \times 26 \times 26 = 17{,}576$ signals:—enough to *include* a very comprehensive list of Geographical and Telegraphic signals, under the head of General Signals, thus ob-

viating the necessity for any separate designations of "Geographical" and "Telegraph" signals. This would reduce the chances of error in sending and reading, because these signals would never have the same numbers as other signals. These 4-display signals can be called "General Signals" to distinguish them from Battle Signals of one display, and Tactical Signals of three displays. As very great rapidity will not be needed for these signals, let them be preceded by the present "General Signal Call," which is *S* with one upper arm pulsated. This simple system will give us 26 x 26 x 26 = 17,576 signals. Sixty-four seconds should be time enough to make *and repeat* any such signal.

Pulsating Signals.

It has been proposed by different officers to increase the number of signals that can be made by one display, by pulsating different arms. Lieutenant Mustin particularly has applied himself to this, and has suggested a very ingenious scheme for doing it. I myself have naturally devoted more or less time to it; but, apart from the increase in complexity in the apparatus, I have been unable, as yet, to become convinced that one display complicated by pulsations is really any better than three displays uncomplicated by pulsations, or even quite as good. Of course, at first sight, there seem to be certain advantages in using only one display and modifying it by pulsating one or more arms; but I am quite sure that the time required to pulsate, and to have the pulsations accurately read, is at least as great as the time required to make two more displays, if not much greater. And, because there would be more than two hundred of these signals, which may be called "conventional" or "arbitrary" signals, it seems to me that there would be more danger of confusion in differentiating them than there would be in simply reading, in succession, two well-known letters, the displays of which we know "by heart." For instance, it seems to me that to read "J B," and then pick it out in the signal book, would be easier and take less time, than to read the letter "J," and note that, say, the second, third and fourth arms were being pulsated, and then find in the Signal Book the signal corresponding; because pulsating takes much more time than is commonly supposed, for the reason that the pulsating of different arms is confusing to the sight, and must therefore be done slowly, and continued for

a considerable time. Besides this, the number of Tactical Signals that could be made is only, according to Lieutenant Mustin, two hundred and eighty-six (286); whereas, by the plan of having three separate displays, we get seven hundred and two (702) signals. It is true that two hundred and eighty-six (286) signals are considerably more Tactical Signals than are in the present Tactical Signal Book; but there can be no objection against having seven hundred and two (702) Tactical Signals, and there are many advantages in its favor. For instance, if the Admiral wishes to form a fleet on a line of bearing with the flagship bearing north, he has, by the present Signal Book, to make two separate signals; whereas if he had more Tactical Signals available, he could have a separate signal for forming a fleet on each line of bearing. One hundred and twenty-eight (128) signals would be needed, for lines of bearing differing a quarter of a point; but, if we had seven hundred and two (702) Tactical Signals, we could afford this luxury. In order to make signals for Course, Line of Bearing, and for Course and Line of Bearing combined, three hundred and eighty-four (384) signals would be needed; but if we had seven hundred and two (702) Tactical Signals, these three hundred and eighty-four (384) signals would be available, and their use would contribute greatly to quickness and sureness in reading and therefore to tactical efficiency.

But the greatest disadvantage of pulsating various arms for Battle and Tactical Signals is that the whole system breaks down, if any part of the apparatus is deranged. We cannot "pulsate" the third arm, for instance, of an alphabetical flag, or a steam whistle.

Annulling.

If it becomes necessary to annul a signal, *after* the signal of execution has been made, the semaphore itself can be used to make the annulling signal; but if the necessity arises *before* the signal of execution has been made, and *while the display is exhibited*, the safest way is to hoist the Annulling Flag.

Defects and their Remedies.

It is a natural result of having devoted his attention so much during the last ten years to the question of signalling by means of all conceivable kinds of systems, apparatus and schemes, that,

although the plan herein described is the one which, all things considered, seems to the writer the most advantageous at the present time, yet, neverthless, there are perhaps a hundred modifications, both of the apparatus and of the system, in his mind. There are many ways, for instance, in which the apparatus can be made to work more quickly, there are many ways in which the vibration of the arms can be stopped; and there are many ways in which only one display would be needed for making a Tactical Signal. But it is so nearly impossible to get a new thing started in the navy, and so very easy to have it rejected by reason of some derangement, and so very easy for new things to get deranged, that the writer is unable to get his own consent at the present moment to depart from this simple scheme, except very gradually, if only for the reason that *it has passed more than a two-year test* in service, and it has taken seven years to do it! Lieutenant Mustin, for instance, has suggested an ingenious modification to the apparatus, which was outlined in the March number of these PROCEEDINGS; and the present writer recognizes the advantages it attempts. Yet it is along the lines of many others that he has devised himself; and the mere fact that it requires more moving parts aloft (three times as many), is sufficient to make him class it with many others that he has himself designed. In fact, this particular design of Mr. Mustin's is almost exactly one which the present writer made himself a few years ago, and abandoned in favor of the more simple apparatus that has taken shape now. No one who has not had the iron enter into his very soul, in the endeavor to invent new things for the navy, things that are really new and not mere improvements on old things, can imagine the extreme reluctance with which any additional part, no matter how simple, is accepted by a person who has had the bitter experience that the writer has had. It may appear, at first sight, that the semaphore arms could be turned more quickly by the plan suggested by Mr. Mustin, but this is more than doubtful, because though the moment of inertia would be less the resistance of the air would be greater; and besides, the force needed to move the arms themselves is only a small fraction of the total force needed.

It is quite probable, however, that the apparatus, as at present installed in the various battleships, can be modified and im-

proved in many details; and yet it seems sure that every modification and change ought to be one that shall be found absolutely necessary; one that will obviate some trouble found in actual practice. The writer himself has very many modified plans in mind at present, which *seem* to have advantages over the apparatus now installed; but rather than spend the time needed to test them all, is it not better to let experience in actual service point out what is needed? Why waste an indeterminate amount of time with mere questions of detail that cannot affect materially the main question?

Electric Control.

It may be, that the apparatus should eventually be controlled electrically, according to the plan described in my basic patent, like the first one in the New York, the principal reason being that the operator can then be in a protected position, which should be placed wherever convenient in the ship. I will ask any officer who has seen the bridge of a ship, especially a flagship, when the quartermasters and signalmen were making flag signals, to sit down quietly alone, and imagine what would happen to those quartermasters and signalmen in a real naval battle. It is not an answer to say that quartermasters and signalmen have been on deck in the naval battles of the past and have not been killed, because automatic machine guns were not used in the naval battles of the past. Neither is it an answer to assert that signals will not be used in the naval battles of the future, because such an assertion would be trespassing on the realm of prophecy and be unsupported by the facts set forth in naval history. No candid person can read the stories of the naval battles of the past, without becoming convinced that signalling did play, in very many of them, a most important part, and sometimes rescued victory from the very jaws of defeat. Nor can he give any logical reason why our apparatus and signalmen should not be protected as much as possible, if only for use after the heat of the encounter in order to re-form the fleet, and even though he may believe in the efficacy of "Follow my Leader" tactics.

Personnel and Matériel.

But what an enormous amount of energy has been expended in the last twenty years, in drilling with signal flags, in develop-

ing merely personal skill in signalling with flags! Might not some fraction of this energy have been diverted to inventing good apparatus to drill with? Why did we devote all our energies to drilling the personnel in signalling, and none to improving the matériel? Why did we even resist all attempts to improve it? Without intending to disparage the good results of drill, it may be pointed out that the amount of personal skill that can be drilled into any man is limited by the purely human abilities of that man, which cannot be much increased; whereas the possibilities of invention reach out into the infinite. Years of training of the voice, for instance, may enable a man to shout so loudly that he can be heard a few hundred yards; but with the telephone, one can talk over more than a thousand miles.

Perhaps a slight digression may be permitted here, while the writer suggests how prone we all are to attach excessive importance to some one phase of a complex question, and how few can consider a large subject in its entirety, and evaluate justly its component parts. How we all rushed into considerations of the matériel only, of our new navy, and neglected the personnel, until a certain wise man showed us our mistake! Then we all rushed to the other extreme, and got to feeling that the personnel was the only vital thing, forgetting that every navy is composed of two divisions both absolutely necessary and indissolubly linked together, the Personnel and the Matériel. To paraphrase the words of Webster—"Personnel and Matériel; now and forever; one and inseparable." And not only are they inseparable, but they react upon each other; for a highly trained personnel will insist upon the proper matériel to use; and a highly organized matériel will require the proper personnel to use it. We cannot even imagine one without imagining the other; for a personnel cannot be highly trained, unless it have daily contact with the proper matériel; and the very best matériel, unless cared for by the proper personnel, will perish from the earth.

Wireless Telegraphy.

The writer has often been asked why he has taken so much trouble to develop this Semaphore System, when it is only a question of time, (and perhaps a very short time) when wireless telegraphy will supersede it, no matter how good the semaphore

system may be. His answer to this has always been that it was only after very laborious study of wireless telegraphy, (or, as it used to be called, "signalling by induction") that he adopted the semaphore idea; and his reason was that he became convinced that, no matter how great the distance may become over which wireless telegraphy can be used, and no matter how many ships and shore stations may use it, and no matter how valuable it may be in a fleet when the enemy is far away, it will nevertheless be almost worthless when the enemy is near. And why? Wireless telegraphy is nothing more than a system of sending messages through one common medium, the ether; so that wireless messages are liable to the same confusion, if a number are simultaneously sent, as are telegraph messages sent over a single wire, or sounds sent through the air. And the more wireless apparatus there are, and the greater the distances over which the numerous messages are sent, the greater will be the confusion. Syntonism, if ever attained, will help matters; but syntonism itself can be made the means of "interfering" intentionally with an enemy's wireless signals, and making them unintelligible; it is merely necessary to fill the ether with Hertzian waves from a few transmitters, whose capacity, resistance and inductance are adjustable.

Now, it is essential to have a system by which signals can be sent *in the absolute presence of the enemy;* that is the critical situation. Wireless telegraphy cannot be relied on for this, but this semaphore system can.

It is, of course, equally true that the semaphore cannot send distant signals, like the wireless. Each system has its value and its limitations; let each be used to do its proper work. Ne sutor ultra crepidem.

Shapes, Day Fireworks, &c., &c.

The semaphore system described in this paper is not, as some people, unfamiliar with the processes of invention, may suppose, the embodiment in iron and brass of a sudden conception of the mind. It is, on the contrary, the slow result of an extremely tedious and laborious series of trials and experiments, whereby a fairly successful apparatus has been evolved, after a long process of elimination. The writer's attempts to improve our systems of signalling began in 1879, when he amused the officers

of the Powhatan by signalling two miles, from a dinghy, by means of a deck-lamp secured inside of a box, which was held by a strap around his neck, while he worked a shutter, covering a hole in the box. This device was much better than the unwieldy torch then used, especially at sea; but its only reward was ridicule. During 1887 and 1888, the writer devoted most of his spare time and money to signalling by electric induction in various ways; to signalling by electricity through the water; and to signalling by sound through the water; but without practical success. In 1895, he took up the question of visible signals seriously; and if any one can name or suggest, any shape, or form, or color, or anything that is visible, which he did not try, he will be glad to know what it is. He worked out one cone, cylinder, inverted-cone system quite elaborately; but, as a net result, he found that, size for size, weight for weight, a line placed at different angles (i. e. a semaphore) is the most clearly readable thing. He also found that things turned around on pivots can be handled better (very much better) than things hoisted and lowered, such as "shapes," especially in a high wind. Japanese day fireworks cannot be managed at all in a high wind.

One bomb, projected into the air, and exploding there, and causing a dense smoke, may, however, be used effectively, to indicate that the instant has arrived for performing an evolution previously ordered; in other words as a "Signal of Execution."

Vulnerability.

Any signal apparatus, whatever, that is attached to a ship must, like the ship itself, be liable to injury in battle; no matter whether the apparatus consist of semaphores or shapes or flags. But any of these things presents a target that is very small, compared with the mast that supports it, so that the probability must be that the mast will be hit rather than the apparatus it supports. This fact emphasizes the huge proportions and enormous weights of some of our so-called "military" masts, which are distinctly *un*military because they are distinctly out of proportion to their importance. ***Why not use some of this weight for armament, and replace these monster masts with masts as slender as possible, held in position by numerous small stays and backstays?*** The liability of the signal apparatus to destruction will then become extremely slight; and two important additional advantages will accrue:

(a) If one stay be shot away, the other stays and backstays will continue to support the mast.

(b) If the mast be nevertheless shot away, we can clear away the wreck. Imagine trying to clear away the wreck caused by the explosion of a heavy h. e. shell inside a "military" mast! The ship would become unmanageable, with such a wreck under its bows, and no appliances on board could cut it clear, in the short time that would be available in battle.

Effect of Smoke.

The effect of smoke must be to obscure, and sometimes to hide any visible signal, no matter whether it be flag, semaphore, shape, or day firework. For this reason, every ship must have aloft above the smoke in battle a good observer; a very good one. Now this observer, or the mast, or both, may be hit. Therefore, we must have ready a few very simple "follow my leader" manœuvres.

The number of such manœuvres can, however, be only a few; very few. Therefore the necessity still remains for good Battle Signals and Tactical Signals.

Résumé.

This Semaphore System gives us a means whereby, *in the absolute presence of the enemy,*

1. We can send "Letters" in all directions at the rate of ten characters per minute.

2. We can send any one of twenty-six Battle Signals, *and have it repeated,* in sixteen seconds.

3. We can send any one of 676 Tactical Signals, *and have it repeated,* in forty-eight seconds.

4. We can send any one of 17,576 General Signals, *and have it repeated,* in sixty-four seconds.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A NAVAL TELESCOPE AND MOUNT.

By COMMANDER BRADLEY A. FISKE, U. S. NAVY.

Intimately connected with signalling is the reading of signals; so, it is amazing that, among all the sundry and manifold changes proposed for making signals, it has not occurred to any one to change in the least the instrument used for reading them; as well as for examining distant ships in wartime, and getting information generally.

Two years ago, the writer made a series of extensive (and, he is sorry to say, very expensive) experiments along this line, and finally invented the apparatus shown in the figures. It consists simply of a very fine telescope and Hastings inverting prism, with 4-inch object glass, which is mounted on a vertical pivot, and fitted with a clamp to hold it there when desired; and which has, in addition, and as its specific distinguishing feature, an arrangement whereby the telescope is pivoted for vertical motion *at the eye of the man looking through it*, so that this man does not have to bob up and down, in a vain endeavor to keep his telescope pointed at the object, as the ship rolls. But he rests his forehead against a firm yet flexible head-rest, and so is absolutely steady and fixed in position; and he moves the telescope up and down by means of the lever shown, without having to change in the least the position of his head, or to derange his line of sight. The telescope is counterweighted by weights that slide in the tubes shown near the outer end of the telescope.

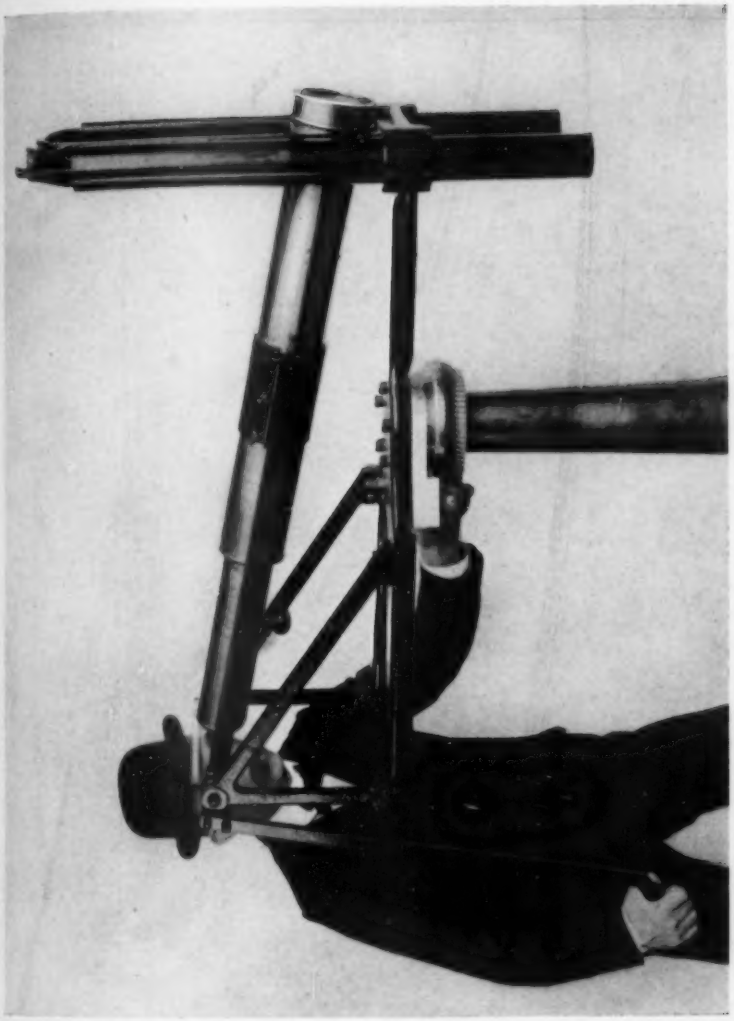
This apparatus was put in the Massachusetts in November, 1901, for trial and report. It proved of extraordinary usefulness, one of its minor feats being the reading, by a signal boy,

of a semaphore message from the Kearsarge, six sea-miles distant, in Trinidad. The Captain made a favorable report on it. This was in May, 1902. Its removal from the ship was immediately ordered from Washington.

When the time came, in the middle of July, 1902, for the Massachusetts, with the rest of the fleet, to start on the "search," the problem presented itself of how to avail ourselves of the usefulness of this instrument. Finally, as executive officer of the ship made a direct request of the captain to be permitted to put back the instrument into the ship, arguing that the order to take it out of the ship need not to be construed as a perpetual prohibition against my using my own instrument, on board the ship to which I was attached, or even against my permitting others to use it, especially as its use would not injuriously affect the Naval service. After some deliberation, the captain concluded that it was within his power to permit me to put back the instrument into the ship; also to permit me to use it myself, and also to permit me to permit others to use it; provided it were used unofficially.

The result was that the Massachusetts could distinguish distant vessels about twice as far as the other ships could; and it discovered several things that the other ships did not discover, for instance, the passing of the Dolphin several miles away, flying the Secretary's flag, and the passing of Pillsbury's squadron, the object of our search.

I obtained the permission of the captain, also, to retain the instrument on board, unofficially, during the winter maneuvers of 1902-1903, and it was in almost continual use thereafter in approaching land, reading distant signals and during target practice. It was also called into frequent requisition for sighting distant vessels, and for doing all the sundry and manifold things that a war ship telescope is called upon to do; and during the "Search" Admiral Higginson borrowed it. When I left the Massachusetts in May, 1903, the telescope was finally removed from the ship.



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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

U. S. NAVAL PROPELLERS—A REPLY.*

By Asst.-Naval Constructor T. G. Roberts, U. S. Navy.

In the May number of the Journal of the American Society of Naval Engineers an article appeared entitled "Screw Propellers of U. S. Naval Vessels," by Lieut. C. W. Dyson, U. S. N. In criticising a given propeller from its performance the term "critical speed" was used to denote the break in the curve of "wake coefficient," where it changed direction and turned rapidly upward near the top speed, the basis of reference being as to the sufficiency of propeller surface. M is considered the wake coefficient, as determined from $V = M S$ where S is the speed of ship, and V the "speed of the water in which the propeller works." V is determined from the formulas by the aid of the logarithmic curves, which give the same results as Barnaby's tables; hence, M contains the resultant compounding of the 10% wake correction already inherent in the logarithmic curves, and is in error by that amount. Furthermore the definitions determining M appear somewhat different from the accepted theories.

It is my purpose to prove that the curves of *M* are derived from erroneous assumptions, and that the conclusions drawn from them are likewise in error. The correct curve that indicates the value of the propeller is the curve of slip, as was originally pointed out by me in the reports of the trials of the Torpedo Boat Destroyers Paul Jones, Perry, and Preble, over a year ago; I characterized the break in the curve of slip, as the point indicating the "critical speed," due principally to insufficiency of propeller surface to attain a higher speed without

*Not being a member of the Society of Naval Engineers, the author makes reply through the Naval Institute.

cavitation. I note that Mr. Dyson applies the identical method of criticism to the M curves, and I desire to prove that my method is correct. For the sake of clearness the curves presented in Mr. Dyson's article are reproduced in Fig. 1. The curves of speed and power are evidently reproduced from my original drawings.

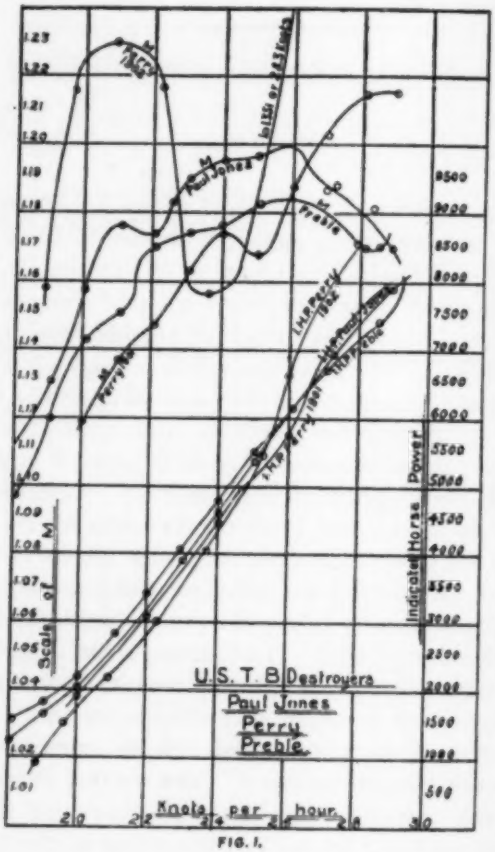

FIG. 1.

The curves of apparent slip are shown in Fig. 2; they were originally prepared and used in locating cavitation, the cause of vibrations and lack of speed, on the Perry, as well as in correcting these errors on the Paul Jones.

Towards the top speed the curves of slip change direction and turn upward; that marks the true point of critical speed. If

the vessel's displacement be decreased, the critical speed would increase, and vice versa; and if the propeller surface were increased, the critical speed would increase, and of this, also, the reverse is true. In a given vessel the critical speed marks the point where the revolutions and horsepower increase abnormally for a small increment of speed; and vibrations begin, the cause being cavitation.

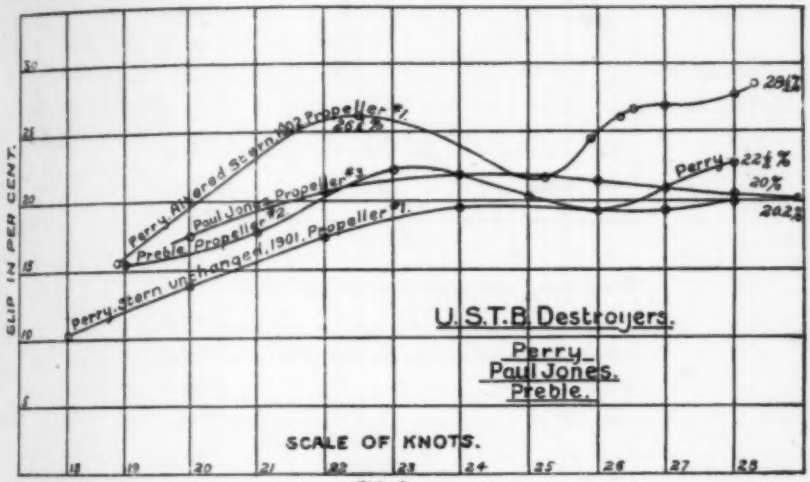

FIG. 2.

In Fig. 3 I have reproduced the Perry's curves from Fig. 1, and have added to it the curve of slip for this vessel taken from Fig. 2, but reduced to the proper scale. The so-called wake-coefficient curve M would indicate the critical speed at 23½ knots, but there is nothing abnormal in the performance of the vessel at that speed. The break in the curve of slip indicates 25¼ knots as the point where abnormal conditions begin, beyond which the hump in the power curve appears.

In order to emphasize the correctness of my contention, the Perry's curve of revolutions and speed has been reproduced in Fig. 4; there is nothing wrong at 23½ knots, but at 25¼ knots the point of disturbance begins.

Recurring to the power and speed curve of Fig. 3, the hump that occurs beyond the 25¼ knot point has the appearance of being due to the wave resistance of the vessel, and I so judged it at first sight. The depth over the course averaged only 12

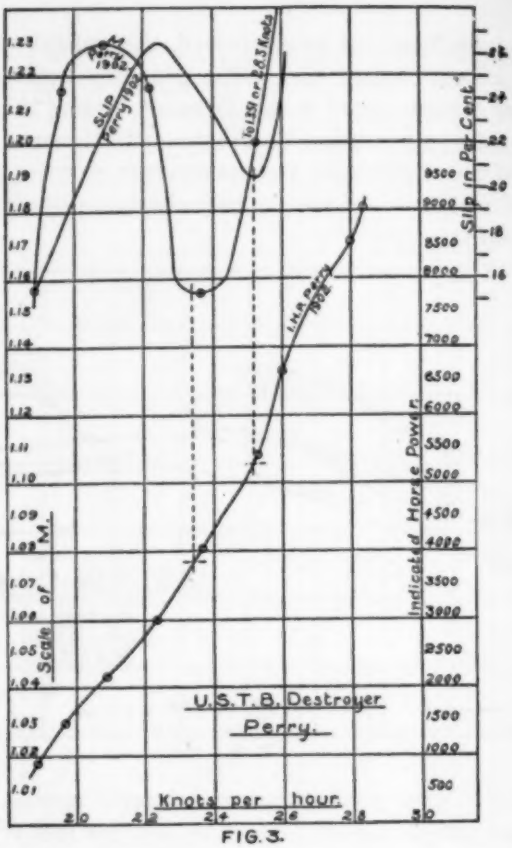
Slip Perry 1902
Vel 19 or 24.3 Knots
I.H.P. Perry 1902
Slip in Per Cent.
Indicated Horse Power
Scale of M.
U.S.T.B. Destroyer
Perry.
Knots per hour.

FIG. 3.

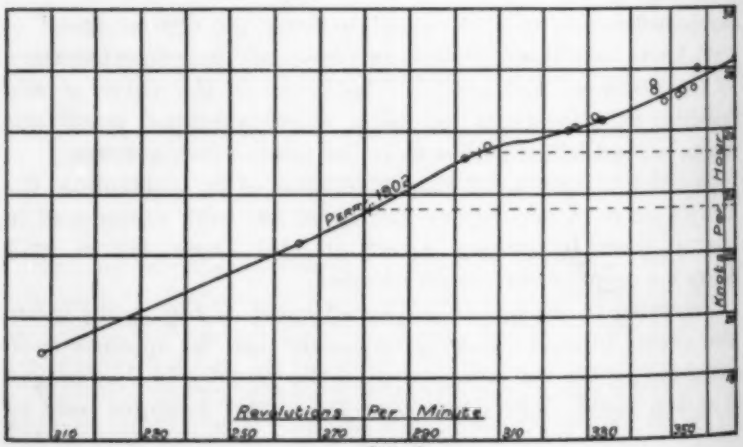
Perry 1902
Revolutions Per Minute
Knots Per Hour

FIG. 4.

fathoms, which portended that this hump might also be due, in part, to a shallow water resistance.

It required considerable investigation to eliminate the two last-mentioned, and other, probable causes before it could be stated definitely that insufficient propeller surface was the cause of this hump. In designing the propellers of the Paul Jones I followed these conclusions solely, with the result that the high speed was attained without vibrations, and without reaching a critical speed with its attendant evils.

It is evident that the wake-coefficient curve *M* is only correct in so far as it bears a general resemblance to the curve of slip, and is in error by the amount it differs therefrom.

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TRI-RECTANGULAR COORDINATES FOR THE SOLUTION OF SPHERICAL TRIANGLES.

By Lieutenant Armistead Rust, U. S. N.

Time-Altitude-Azimuth, Ex-Meridian and Prime-Vertical Diagrams.

For Identifying Unknown Stars, Finding the Hour Angle, Altitude, and Azimuth of a Known Body, Hour Angles and Times of Rising and Setting and Crossing the Prime-Vertical; the Compass Error, Latitude and Longitude, and also to facilitate the Plotting of Sumner's Lines on the Chart, and for finding the Great Circle Course and Distance.

1. To identify an unknown star in cloudy weather we have given, or may obtain:

(1) The Greenwich mean time.
(2) The ship's position by D. R.
(3) The star's observed altitude.
(4) The star's observed azimuth.

Find the true altitude and the true azimuth, and the local sidereal time.

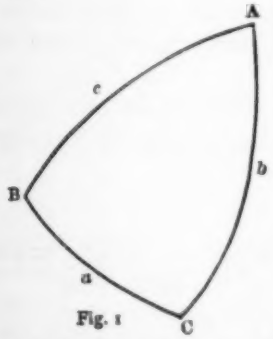


Fig. 1

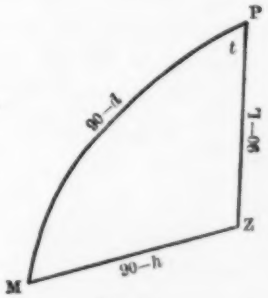


Fig. 2

In the spherical triangle ABC, if we have given the two sides a, b and the angle C, we may find A and B from formulas (1) and (2) and then c from (3) and (4).

$$(1)\ \tan\tfrac{1}{2}(A+B)=\frac{\cos\frac{1}{2}(a-b)}{\cos\frac{1}{2}(a+b)}\cot\tfrac{1}{2}C,$$

$$(2)\ \tan\tfrac{1}{2}(A-B)=\frac{\sin\frac{1}{2}(a-b)}{\sin\frac{1}{2}(a+b)}\cot\tfrac{1}{2}C,$$

$$(3)\ \tan\tfrac{1}{2}(c+a)=\frac{\cos\frac{1}{2}(C-A)}{\cos\frac{1}{2}(C+A)}\tan\tfrac{1}{2}b,$$

$$(4)\ \tan\tfrac{1}{2}(c-a)=\frac{\sin\frac{1}{2}(C-A)}{\sin\frac{1}{2}(C+A)}\tan\tfrac{1}{2}b.$$

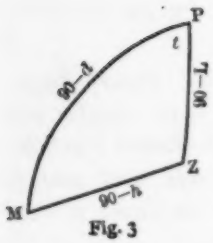


Fig. 3

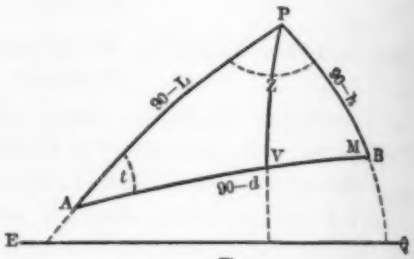


Fig. 4

In the astronomical triangle PMZ let

$90°-h=a$	$t=A$	Where t = hour angle,
$90°-L=b$	$M=B$	h = altitude,
$90°-d=c$	$Z=C$	L = latitude,
		d = declination and
		Z = azimuth.

Example: At sea, Feb. 26, 1901, 6.30 p. m., L. M. T., weather overcast and cloudy. Observed the altitude of an unknown star, about second magnitude, through a break in the clouds, 29° 30′ (true), bearing N. 74° W. (true).

What is the name of the star? Position by dead reckoning Lat. 35° N. and Long. 60° W. Substituting in formulas (1) and (2).

We have

$a=90°-h=60°\ 30'$, $b=90°-L=55°$, $C=Z=74°$

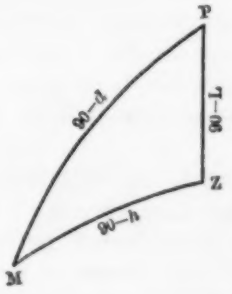
$\frac{1}{2}(a-b)=$	$2°\,45'$	cos 9.99950	sin 8.68104,
$\frac{1}{2}(a+b)=$	$57°\,45'$	sec 0.27277	cosec 0.07277,
$\frac{1}{2}Z=$	$37°$	cot 0.12289	cot 0.12289,
$\frac{1}{2}(A+B)=$	$68°\,04'$	tan 10.39516	tan 8.87670,
$\frac{1}{2}(A-B)=$	$4°\,18'$		
$A=$	$72°\,22'$	or t = 4 hrs. 49 min. 28 sec.	

Using this value of A in formulas (3) and (4) with $C = 74°$ and $b = 55°$ we have

$\frac{1}{2}(C-A) =$	$0°\ 49'$	cos 9.99996	sin 8.15391,
$\frac{1}{2}(C+A) =$	$73°\ 11'$	sec 0.53864	cosec 0.01898,
$\frac{1}{2}\ b\ =$	$27°\ 30'$	tan 9.71648	tan 9.71648,
$\frac{1}{2}(c+a) =$	$60°\ 56'$	tan 10.25508	tan 7.88937,
$\frac{1}{2}(c-a) =$	$0°\ 26'$		
c	$= 61°\ 22' = 90° - d$, hence $d = 28°\ 38'$ N.		
a	$= 60°\ 30' = 90° - h$, hence $h = 29°\ 30$,		

L.M.T.	6 — 30 — 00	
R.A.M.S.	22 — 22 — 33	* R.A. 0 — 04 — 48,
cor. G.M.T.	1 — 43	* Dec 28° 38′ N and in the Star Tables
L.S.T.	4 — 54 — 16	these correspond to α Andromedæ
*H.A.	4 — 49 — 28	(2nd Mag.) * R.A. 0 — 03 — 19
*R.A.	0 — 04 — 48	* Dec 28° 33′ N.

It is not pretended that this is a satisfactory way to identify a star. The necessary calculations are too long and in some cases the problem is practically indeterminate on account of the double values which may be assigned to some of the angles. In order to solve the problem satisfactorily, except when the star is near the meridian, tables of some kind must be used; several of these are published, but they all require more or less computation.



2. Captain Lecky's "General Utility—A, B, C, and D Tables" may be used for finding the hour angle of a star from its altitude and azimuth, but not its declination.

F. B. S. Lawlor, R. N. R., has shown how certain tables in Norie's Epitome may be used for the identification of an unknown star by its altitude and azimuth.

3. Realizing the importance of this problem to the practical

navigator, the writer suggested that the time-azimuth tables issued by the Navy Department be modified as shown in the enclosed table, in which for each degree of latitude and declination is given the altitude as well as the azimuth corresponding to the given hour angles. This can be done by means of the formula $\sin h = \cos (L-d) - 2 \cos L \cos d \sin \frac{1}{2} t$. Referring to the example on page 1—Entering the table with the given altitude 29°30′ and azimuth N. 74° W., the hour angle 4 hrs. 50 min. and declination 28° 30′ N. are taken out at once.

4. Among the valuable works on Navigation published by A. C. Johnson, R. N., is "Combined Time and Altitude-Azimuth Tables," which from the name would seem to be just such tables as those proposed, but upon examination they prove quite different, namely, for finding the azimuth of a known body in high latitudes.

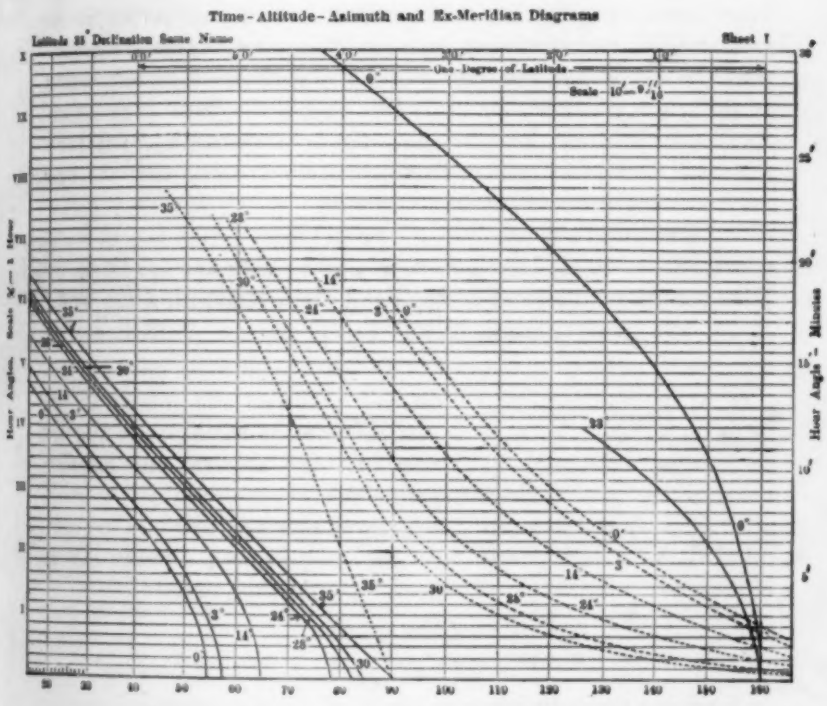
5. The graphical method by Captain C. D. Sigsbee, U. S. Navy, is a good one, but it is believed that for the solution of this problem with the greatest speed and accuracy, the *Time-Altitude-Azimuth Diagrams* will be found more convenient than any other way. These are based on the graphical solution of the spherical triangle by what may be called *Tri-rectangular Coordinates.*

6. In the astronomical triangle PMZ, suppose L and d constant while t and h vary, and if for the different values of t we compute the corresponding values of h and Z, then we can construct two curves, one having hour angles as ordinates and altitudes as abscissas, while the other has hour angles as ordinates and azimuths as abscissas, the common ordinate forming the connecting link between the two.

7. Referring to Sheet I, the ordinates represent hour angles and the horizontal index lines are drawn at intervals of 10 min. of hour angle.* The time-altitude curves, shown by the full lines in the left hand lower corner of the diagram, are laid off with hour angles as ordinates and the corresponding altitudes as abscissas. One of these curves is drawn for each degree of declination used. The time-azimuth curves shown by the dotted lines in the center of the diagram are plotted with the hour angles as ordinates and the corresponding azimuths as abscissas. One of these curves is also drawn for each degree of declination used.

* On the sheets used in practice these lines are at intervals of 2 min.

8. The curves shown by the full lines extending from the right hand lower corner of Sheet I to the top of the diagram are the portions of the time-altitude curves near the meridian expanded on a large scale for declinations 0° and 23°, and the abscissas represent the difference in minutes to be added to the observed ex-meridian altitude to obtain the observed meridian altitude, at the place of observation, which altitude or rather the latitude found from it must be corrected for the run of the ship to noon.



9. From an examination of the diagrams on Sheet I it will be seen that the following problems may be readily and accurately solved:

PROBLEM I.—To identify an unknown star.

Any horizontal index line cuts all of the time-altitude and time-azimuth curves, and perpendiculars from the points of its intersection with these curves (corresponding to the same declination, and these are all numbered so as to be readily identified)

to the base line will intercept on the base line the altitude and azimuth of the body having the given declination and the assumed hour angle, hence in order to identify an unknown star: At the same time that the altitude is observed take a compass bearing of the star and note the time by watch. Reduce the observed altitude to true, find the true azimuth and the local sidereal time.

10. On the base line lay off the true altitude and azimuth, and at these points erect perpendiculars to the base line, or follow up the sheet along the vertical lines with the forefinger of each hand, until an index line is reached on which each perpendicular intersects its corresponding curve of the same degree of declination. We thus find the hour angle and declination corresponding to the given altitude and azimuth. Apply the hour angle to the local sidereal time for the star's right ascension and with this and the declination taken from the curves used, take the star from the list in the Nautical Almanac.

11. Example: At sea, Feb. 26, 1901, about 5.30 p. m.; G. M. T. 9 hrs. 36 m. 00 s., Lat. 35° 00′ N., Long., 60° 00′ W. by D. R. Observed the altitude of a star (2nd mag.) through a rift in the clouds 20° (true) bearing N. 86° 30′ W. (true). Find the star.

L. M. T.	5 — 36 — 00
R. A. M. S.	22 — 22 — 33
Cor.	0 — 01 — 35
L. S. T.	3 — 59 — 08
* H. A.	+ 5 — 00 — 00
* R. A.	22 — 59 — 08

Lay off the altitude and azimuth on the base line and follow up the vertical lines at these points and we find that the altitude and azimuth perpendiculars intersect on the index line corresponding to 5 hrs. 00 min. on the altitude and azimuth curves of 14° declination, hence

* H. A. = 5 hrs. 00 min.
* dec. = 14° 00′

Applying the hour angle to the L. S. T. we obtain—

* R. A. 22—59—08 and dec. 14° N., hence from the star list we find the star must be *a* Pegasi (Markab).

In the same way the example given on page 1 can be solved and we find—

* H. A. = 4 hrs. 50 min., * dec. 28° N. and * R. A. = 0 hrs. 04 min.

These results are almost exactly the same as those obtained by solving the problem by trigonometry; by increasing the scale of the diagrams even greater accuracy may be expected.

12. PROBLEM II.—To find the hour angle, altitude or azimuth of a known body at any given time.

If any one of these is known or can be obtained the other two may be found directly from the diagram. Take an altitude or azimuth of the star and its azimuth or altitude and hour angle may be found from Sheet I. Or if it be desired to locate some particular star at a certain time, find its hour angle at this time, and from Sheet I find its altitude and azimuth, which placed on the sextant and pelorus will enable the observer to pick up the star at once with the minimum amount of calculation.

13. PROBLEM III.—To find the time of rising and setting.

In practice the altitudes will be laid off from 0° to 90° and the azimuths from 0° to 180°. This was not done on the sample Sheet I for lack of space. The points where the altitude curves cut the ordinate at 0° will give the hour angle of rising and setting, and this applied to the time of meridian passage will give the times of rising and setting. The azimuths at rising and setting may be obtained from the intersection of the index lines through these points with the azimuth curves.

14. PROBLEM IV.—To find the approximate altitude and hour angle of a body on the prime vertical.

This problem is useful in constructing the prime vertical diagram for finding the longitude. Erect a perpendicular to the base line at 90°. The ordinate of the intersection of this perpendicular with the azimuth curve corresponding to the declination of the body will give its approximate hour angle and the intersection of the index line through this point with the altitude curve will give its altitude. Thus the altitude of *a* Andromedæ when on the prime vertical is about 54° and its hour angle about 2 hours 44 min.

15. PROBLEM V.—To find the compass error.

Sheet I may be used as either a time-azimuth diagram for the sun or the stars or an altitude-azimuth diagram as is most convenient.

Example: Feb. 26, 1901. At sea 7.00 p. m. observed altitude of *a* Andromedæ 24° (true) bearing by compass N. 76° W. Find the compass error.

From Sheet I—True bearing.....N. 72° W.
Compass bearing .....N. 76° W.
Compass Error .....4° E.

16. PROBLEM VI.—To find the latitude—(1) by ex-meridian altitudes.

Example: At sea March 21, 1902, Lat. 35° 00′ by D. R., Long. 15° 00′ W.

Observed altitude of 54° 30′, L. A. T. 11 hrs. 40 min., 30 sec. from A. M. time sight, corrected for run. Entering the right hand margin Sheet I with the sun's hour angle 19 min. 30 sec. from the curve for declination 0° (sun's Dec. March 21) we find the difference 0° 18′ to be added to the observed altitude to obtain the meridian altitude at the place of observation, and the latitude found from it must be corrected for the run of the ship to noon.

Obs. alt. ⊙	54° 30′
Cor. Sheet I.	0 18′
" for S. D. &c.	11′
True Alt. —⊙—	54° 59′
	90° 00′
M. Z. D.	35° 01′ N
Dec.	0 00
Lat.	35° 01′ N

The ex-meridian altitude curves are carefully calculated by using the various recognized and approved methods for reduction to the meridian, due regard being had for the limiting values of the hour angles, latitude and declination in all cases.

Referring to Sheet I, it will be noticed that the ex-meridian altitude curves converge very rapidly as they approach the meridian, the differences varying as the square of the hour angles, so that it may be difficult to distinguish the lines when the hour angles are small, and for those who wish extreme accuracy proceed as follows:

$$(t + d)^2 : t^2 :: D : x$$

Where t = hour angle of observation in minutes.
d = difference between hour angles.
$(t + d)$ = hour angle taken from diagram.
D = difference corresponding to $(t + d)$.
x = No. min. to be added to observed altitude to obtain the required meridian altitude corresponding to H. A. t.

17. PROBLEM VII.—To find the latitude (2) by star double-altitudes.

This method is described by A. C. Johnson, R. N., as follows: If two altitudes be taken, and the hour angles worked out with the latitude by D. R., their sum, if on opposite sides of the meridian, or their difference, if on the same side, should, if the latitude

is correct, agree with the difference of their right ascensions; if there is any discrepancy it shows that the latitude used is incorrect. (For complete description of this method see "Hand-Book for Star Double Altitudes," by A. C. Johnson, R. N., published by J. D. Potter, 11 King Street, Tower Hill, E., London.)

Example: At sea Feb. 26, 1901, about 6.30 p. m., G. M. T. 10—30—00, Lat. 35° 00′ N., Long. 60° 00′ W. by D. R. The true altitude of *a* Andromedæ was 29° 30′ west of meridian and that of *a* Orionis 59° 55′, east of meridian. Find the latitude. We find L. S. T. = 4—54—16.

a Andromedæ — * R. A.	0—03—19	Dec. 28° 33′ N.
a Orionis — * R. A.	5—49—52	Dec. 7° 23′ N.
True interval	5—46—33—	

Enter with the altitudes on Sheet I and find the hour angle of each star and the corresponding azimuths. It is assumed that Sheet I is on a sufficiently large scale for this to be done accurately.

a Andromedæ H. A.	+4—49—28	Bearing N 74° W .36 (a),
a Orionis H. A.	—0—55—36	" S 65° E .58 (b),
Computed interval	5—45—04+	(a) + (b) = .94,
True interval	5—46—33—	$-\frac{22'}{.94} = -23'$,
Difference	0—01—29—	= 22′ in arc.

Assumed Latitude	35° 00′
Cor.	—23′
True Lat.	34° 37′

The corrections (a) and (b) may be taken from Lecky's "C" tables or the one in the above hand-book. "C" = cot Az Sec Lat.

18. PROBLEM VIII.—To find the latitude (3) given the altitude and hour angle of a known star.

As the hour angle is the same function of the latitude as it is of the declination, the places of these may be interchanged on the diagrams. For instance, on Sheet I we may take as legend, "Declination 35° Latitude *same* name," then the different numbers on the curves will stand for latitude. Advantage may be taken of this to find the approximate latitude from the altitude of a star whose hour angle is known. With the given altitude and hour angle enter the sheet with the same latitude as the declination of the body, the altitude ordinate will then intersect the index line through the hour angle on an altitude curve whose number will give the approximate latitude.

Example: In south latitude, Long. 60° 00′ W., Feb. 26, 1901, L. M. T. 6—04—10 the true altitude of * Castor east of the meridian was 10° 00′. Find the approximate latitude.

* Castor R. A. 7-28-21.
Dec. 32° 06′ N.

L.M.T.	6—04 10
R.A.M.S.	22—22—33,
Cor.	1—38,
L.S.T.	4—28—21,
* R. A.	7—28—21,
* H. A.	—3—00—00.

On Sheet III[1] latitude 32° as declination, altitude 10° and H. A.= 3—00, we find that the ordinates through these points give latitude 36° S. (contrary name to declination).

In order to apply Problems VII and VIII in practice the hour angles should be found by means of the prime vertical or hour angle diagram, Sheet II. The minutes of latitude and declination may be easily interpolated for.

19. Problem IX.—To find the exact hour angle and the longitude.

The hour angle and hence the longitude may be accurately found with the aid of the hour angle or *prime vertical diagram* shown on Sheet II.

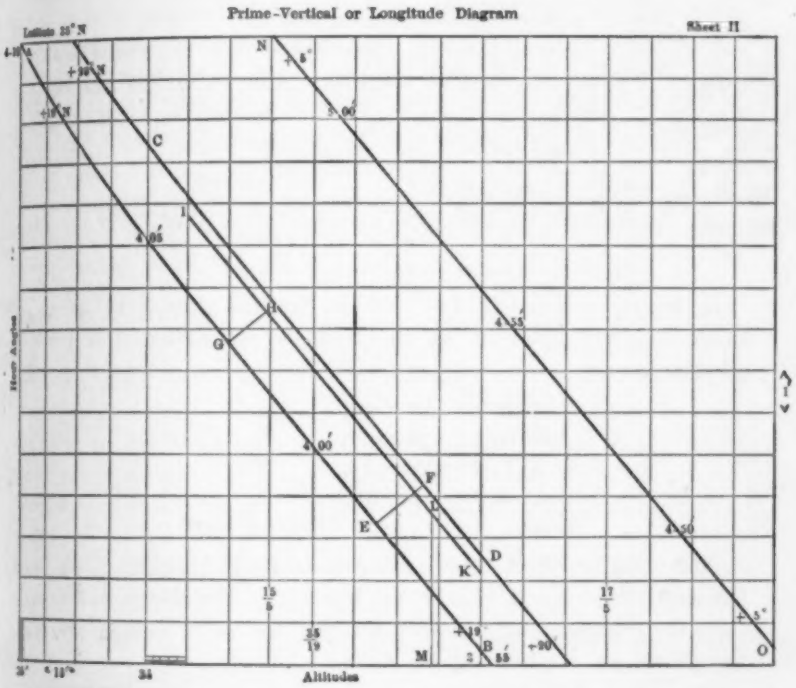
Here the portion of the time-altitude curve near the prime vertical is expanded on a large scale, as was done with the ex-meridian altitude curves. As near the prime vertical the altitude varies uniformly with the hour angle, this part of the curve is a straight line, and it is only necessary to establish two points within the limits of the diagram, though a third should be established as a check. Of course the hour angle diagram may be plotted at a distance from the prime vertical, though more points will have to be found to establish the curve. This diagram will be found very convenient for navigators making long passages on nearly east and west courses, as the same curves may then be used from day to day, and the hour angle taken directly from the diagram without any calculation whatever, and with the same degree of accuracy as though it were calculated in the usual way. This will be demonstrated by some examples given later. This diagram is particularly convenient for use with stars as the declination is practically constant, but it may be used also with the sun at the sacrifice of a very little additional time and labor than is necessary with a star.

[1] Omitted.

Sheet I will be found very convenient for checking the hour angles when working time sights in the usual way.

20. About 4.00 p. m., May 20, 1902. In Lat. 35° 10′ N., find the hour angle of the sun west of the meridian, true altitude of 35° 43′ and corrected Dec. 19° 47′ N.

Referring to Sheet I, it is seen that at this altitude the sun is near the prime vertical and to make a diagram that may be used



from day to day when desired, with Lat. 35° N. and Dec. 19° 00′ N., compute the hour angles for altitudes 33° 00′ and 36° 00′, these are 4 hrs. 09 min. 55 sec. and 3 hrs. 55 min. 16 sec., respectively. Plot the points A and B and draw a straight line between them, Sheet II. If another point be established with any intermediate altitude this point will be found to fall exactly on the line AB. With altitudes 34° 00′ and 36° 00′ and Dec. 20° 00′ N., in the same way establish the points C and D and draw the line CD. The distance EF between AB and CD is due to the difference in declination of one degree. Take EF in the dividers

and apply it to the scale of minutes at the bottom of the diagram, EF = 23′, then to find the line for 47′ of declination we have $\frac{23'}{60} \times 47 = 18'$ on the same scale. From AB lay off GH = 18′ and through H draw IK parallel to AB. Lay off the altitude 35° 43′ on the base line. The perpendicular at this point M, cutting IK in L, gives the required hour angle of 3 hrs. 58 min. 35 sec. By calculation it is 3 hrs. 58 min. 33 sec. The process in the case of a star is still more simple.

Example: At sea, Jan. 31, 1901, about 6 p. m., the true altitude of * Procyron, east of meridian, was 15° 41′ 30″, G. M. T. 4—30—57, ship's position by D. R., Lat. 35° 00′ N., Long. 20° 50′ E. Find the longitude and plot the Sumner line.

G. M. T.	4 — 30 — 57	* Procyron,
R. A. M. S.	20 — 40 — 03	* R. A. 7 — 34 — 07,
Cor.	— 46	* Dec. 5° 29′ N.
G. S. T.	1 — 11 — 46	

Referring to Sheet II, line NO, we find for altitude 15° 41′ 30″, H. A. = 4 hrs. 58 min. 45 sec. and by calculation it is 4 hrs. 58 min. 40 sec.

* H. A.	4 — 58 — 45,
* R. A.	7 — 34 — 07,
L. S. T.	2 — 35 — 22,
G. S. T.	1 — 11 — 46,
Long.	1 — 23 — 36 = 20° 54′ East.

Referring to Sheet I, for hour angles 4—58 and Dec. 5° 29′ N., the azimuth is N. 94° E., or the bearing of the star is S. 86° E., thus the Sumner line is drawn through the point Lat. 35° 00′ N., Long. 20° 54′ E., bearing N. 4° E.

21. The fact that the hour angles taken from the diagrams do not in all cases agree with the computed values of the same more closely is due to inaccuracies in laying off the diagrams and the smallness of the scale, as the principle on which the diagrams are constructed is correct. The blank sheets for the *prime vertical* or *hour angle diagrams* should be constructed and engraved with the utmost care and accuracy on a scale sufficiently large to enable the hour angle to be taken from it to the second, the sheet being of sufficient size to include at least half an hour of hour angle. A Mercator chart on a large scale for low latitudes makes an excellent sheet for plotting the *hour angle diagram* and the writer

has obtained results in this way which agreed wtih the computed angles to a second. In practice a number of these blank diagrams (Sheet II) engraved on good hard paper should be furnished. On these the time-altitude curves would ordinarily be drawn in pencil, and erased when of no further use, to make room for new ones, though it will sometimes be found convenient to ink these in for the stars. The lines indicating the hour angles, altitudes and declinations should be marked as shown on Sheet II. The hour angle and declination are marked near the time-altitude curves and the altitudes written over their corresponding declinations, thus $\frac{35}{19}$, $\frac{15}{5}$ mean alt. 35° for dec. 19°, and alt. 15° for dec. 5°, etc. In this way a number of curves may be drawn on a single sheet without any risk of confusion. From an examination of Sheet I it will be seen that the time-altitude curve is in many cases a straight line for some distance on either side of the prime vertical, and is thus available for plotting on a large scale for use in finding the hour angle.

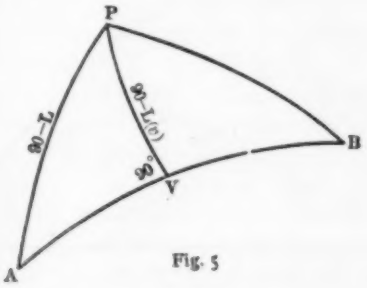


Fig. 5

22. Problem X.—To find the *great circle course* and *distance* between two given points.

It is evident that the problems of *great circle sailing* may be readily solved by means of the *time-altitude-azimuth diagrams* by simply renaming the parts of the triangle and diagrams.

In formulas (1), (2), (3), (4), paragraph 1,

Let C = Z = L° = difference of longitude between the two places.

A = t = A = course from A.

B = M = B = course from B.

a = 90°—h = 90° — L″ = complement of greater latitude.

b = 90° — L = 90° — L′ = complement of lesser latitude.

c = 90° — d = D = distance between places A and B.

Let L′=(90°—PA) the latitude of A, or the less latitude.
L″=(90°—PB) the latitude of B, or the greater latitude.
L°= the difference of longitude from B to A = APB.
Lg′= the longitude of the vertex from PA, or APV°.
Lg″= the longitude of the vertex from PB, or BPV.
L(v)=(90°—PV) the latitude of the vertex.
D(Lg)= 1/2(Lg′— Lg″).

Then to find the great circle course and distance from A to B: Enter Sheet I of same degree of latitude as the place of departure, with the latitude of destination as an altitude and the difference of longitude in arc as azimuth. The intersection of the perpendiculars on the line of declination will give from the number of the line the complement of the distance in degrees, and the corresponding hour angle reduced to arc will be the course. The final course may be found in the same way by reversing the process and entering the sheet of the same latitude as the port of destination.

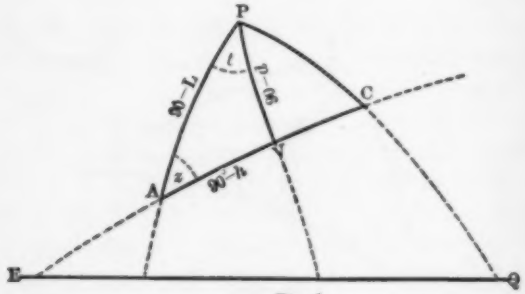


Fig. 6

Example: Find the Great Circle Course and distance from Ocracoke Inlet (A) in Lat. 35° 00′ N., Long. 76° 00′ W., to the Strait of Gibraltar (B) in Lat. 36° 00′ N., Long. 5° 30′ W.

Here we have the

Lat. (A) =	35° 00′ N	Long. (A) =	76° 00′ W,
Lat. (B) =	36° 00′ N	" (B) =	5° 30′ W,
		Difference	70° 30′

Entering Sheet I as directed above, we find A = 4 hrs. 28 min. for the course from A = in arc N. 67° E. and the ordinates intersect on the index line for this hour angle corresponding to the declination curves of 34°; hence 90°— 34°= 56°= distance from A to B or d = 3360 miles.

The logarithmic work for this problem is given below:

Lat. (B), $L'' = 36° 00'$ Long. (B) $= 5° 30'$ W,
" (A), $L' = 35° 00'$ " (A) $= 76° 00'$ W,
$L°$ $=$ (1) $\tan \frac{1}{2} D(Lg) =$
$L'' - L' = 1° 00'$ $L° = 70° 30'$ W,
$L'' + L' = 71° 00'$ $\frac{1}{2} L° = 35° 15'$ $\frac{\sin (L'' - L')}{\sin (L'' + L')} \times \cot \frac{1}{2} L°$,

$L'' + L' = 71° 00'$	cosec 0.02433,
$L'' - L' = 1° 00'$	sin 8.24186,
$\frac{1}{2} L° = 35° 15'$	cot 0.15075,
$\frac{1}{2} D(Lg) = 1° 30'$	tan 8.41694,

$Lg' = \frac{1}{2} L° + D(Lg) = 36° 45'$,
$Lg'' = \frac{1}{2} L° - D(Lg) = 33° 45'$,
Let d′ = distance from A to Vertex,
d″ = " " B " "
d = " " A to B,
$d = d' + d''$.

(2) $\tan d' = \tan Lg' \cos L(v)$,
(3) $\tan d'' = \tan Lg'' \cos L(v)$ A = initial course from A to B,
(4) $\cos A = \sin L(v) \sin Lg'$ B′ = final course to B,
(5) $\cos B = \sin L(v) \sin Lg''$

$Lg' = 36° 45'$	tan 9.87317	$Lg'' = 33° 45'$		tan 9.82489,
$L(v) = 41° 09'$	cos 9.87679			cos 9.87679,
$d' = 29° 21'$	tan 9.74996			
$d'' = 26° 42'$				tan 9.70168,
$d = 56° 03' = 3363$ miles,				
$L(v) = 41° 09'$	sin 9.81825			sin 9.81825,
$Lg' = 36° 45'$	sin 9.77694	$Lg'' = 33° 45'$		sin 9.74474,
$A = N\ 67° 15'$ E	cos 9.59519,			
$B = N\ 68° 45'$ W				cos 9.56299,

Or B′ = S 68° 45′ E final course to B.

Comparing the calculated results with those obtained from the diagrams it is seen that the distances differ only 3 miles and the two values of A only 15′.

23. Problem XI.—To find the latitude of the vertex.

From P draw PV perpendicular to the Great Circle Track, then V is the vertex, and in the right triangle APV we have given:

PVA = 90°; AP = 90° − L; and PAV = course from A found by Problem X. Then we have $\sin PV = \sin A \cos L$, where L = latitude of A.

Hence L(v) = latitude of vertex = 90° — PV.

It is more convenient to find the latitude of the vertex by calculation than from the diagrams, as only two logarithms are required.

$A = 67° 15'$ sin 9.96483,
$L' = 35° 008$ cos 9.91336,
$PV = 49° 04'$ sin 9.87819 = cos L(v),
$L(v) = 90° - PV = 40° 56'$.

24. PROBLEM XII.—To find the meridian of the vertex and its distance from the point of departure.

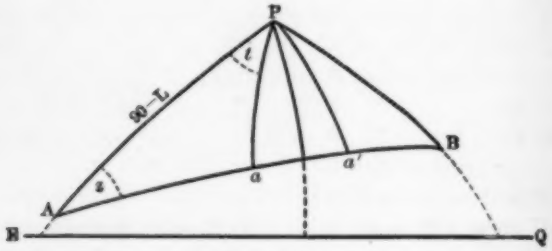


Fig. 6a

Enter the latitude of the place of departure with the initial course as an azimuth, then the intersection of the ordinate through this point with the azimuth curve of the same declination as the latitude of the vertex will give the index line whose corresponding hour angle will be the longitude of the vertex from the place of departure. The abscissa of the intersection of this index line with the altitude curve of the same declination as the latitude of the vertex will give the distance to the meridian of the vertex from the place of departure.

To find the longitude of the vertex from A: In the right-angled triangle APV, by renaming the parts to suit the problem, we have given:

$L = 35° 00'$ N., $L(v) = 40° 56' = d$, $A = Z = 67° 15'$
$AP = 90° - L$, $PV = 90° - L(v) = 90° - d$.

To find $APV = Lg' = t$ = longitude of vertex from A,
$AV = 90° - h$ = distance of vertex from A.

Following the rule given above, we find: $t = 2$ hrs. 27 min. $= 36° 45'$; and $h = 60° 30'$; $90° - h = 29° 30'$.
or distance from A = 1770 miles. Comparing these values with those computed it is seen that the longitudes agree and the distances differ by only 9 miles.

Example: Find the Great Circle Course and distance from Ocracoke Inlet, N. C., to the English Channel near Plymouth. Lat. Ocracoke = 35° 00′ N., Long. 76° 00′ W. (A). Lat. of (B) near Plymouth, 50° 00′ N., Long. (B) 4° 00′ W.

Solving this problem by the diagram we find that A = N. 50° 00′ E. the initial course from A, and d = 3180 miles, distance from A to B.

By Problem XI.—The latitude of the vertex is found to be = 51° 08′.

By Problem XII.—The longitude of the vertex is found to be = 55° 30′.

By computation—A = N. 49° 57′ E. and d = 3178 miles.

L(v) = latitude vertex = 51° 10′.

Lg′ = longitude of vertex from A = 55° 41′.

In some cases it will be found to advantage to find the longitude of the vertex from the destination instead of from the port of departure, as when the ordinate at the given azimuth from the place of departure is tangent to the azimuth curve or cuts it in two points. No confusion need arise, however, as the sum of the longitudes from departure and destination must be equal to the difference of longitude.

25. Problem XIII.—To find the latitudes and longitudes of any number of points in order to plot the track on a chart, having given the latitude and longitude of the vertex.

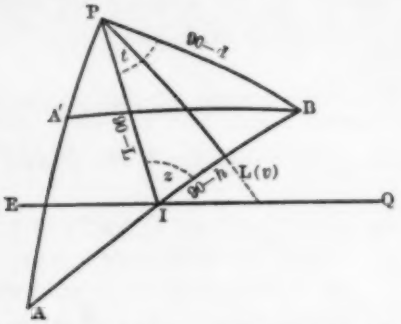
Assume Longitudes of ± 5° or 10° on either side of the meridian of the vertex, then in the triangle APa we have given: A = initial course = Z; AP = 90° − L; APa = t = Lg′ − VPa.

Then with t as an hour angle, and A as an azimuth the ordinates will intersect on the azimuth curve the declination of which will be the latitude of the point a. A few of the latitudes may be calculated by the formula: tan L(a) = tan L(v) cos Lg(a) where L(a) = Lat. of any point a and Lg(a) = Long. any point a. Or we may assume the latitudes and check the longitude found by cos Lg(a) = tan L(a) cot L(v).

26. Problem XIV.—When the point of departure and the destination are on opposite sides of the equator, to find the course and distance and the longitude of the intersection of the great circle with the equator.

Let A and B be the two places and I the intersection of the track AB with the equator. Lay off EA′ = EA = latitude of A. Through A′B draw the arc of a great circle. Then by Problem X

find the courses PA′B and PBA′ and the distance A′B. AA′B = 180° — PA′B. L′ = latitude A, L″ = latitude B. AA′ = 2L′ and A′B has been found. By Problem X find A′AB, A′BA and the distance AB. PBA = PBA′ + A′BA = course from B.



Find the latitude of the vertex by Problem XI. This latitude is equal to the inclination of the plane of the great circle to the equator or course from the intersection towards B = 90° — L(v). Then in latitude 0° with 90° — L(v) as an azimuth, the intersection of the ordinate at this point with the curve of the same declination as the latitude of the destination (B), will determine the index line of the hour angle which is the longitude of the intersection from the destination. By using the latitude of the departure (A) and 90° + L(v) as an azimuth, the longitude from A can be found, entering in this case the sheet of same latitude as A—declination *contrary* name—and using curve for 0° declination.

27. From the above it will be seen that the *Time Altitude Azimuth and Ex-meridian* and *Prime Vertical* or *Hour Angle Diagrams* represent graphically and with mathematical accuracy the paths of the different heavenly bodies whose declinations are used, both in altitude and azimuth, from rising to meridian passage or from meridian passage to setting. In addition to identifying an unknown star with ease and accuracy, and solving all the ordinary problems of astronomical navigation, the most important problems of Great Circle sailing may be quickly solved with the aid of these curves.

28. The diagrams are constructed on sheets 15″ x 20″, one for each degree of latitude from 0° to 60° for latitude and declination *same* and *contrary* name, with declinations from 0° to 62°, including those of the principal stars of the first and second magnitude.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NOTES ON A DIAGRAM FOR FINDING THE AZIMUTH AND HOUR ANGLE FROM THE LATITUDE OF THE OBSERVER, AND THE DECLINATION AND ALTITUDE OF THE OBSERVED CELESTIAL BODY, BY G. W. LITTLEHALES, ESQ., HYDROGRAPHIC ENGINEER.

(Issued with Pilot Charts for February, 1903.)

By LIEUTENANT ARMISTEAD RUST, U. S. N.

Since the preceding paper was written, in November, 1902, the writer has received the Pilot Charts of the North Atlantic and Pacific Oceans, containing the diagram by Mr. Littlehales, of the Hydrographic Office.

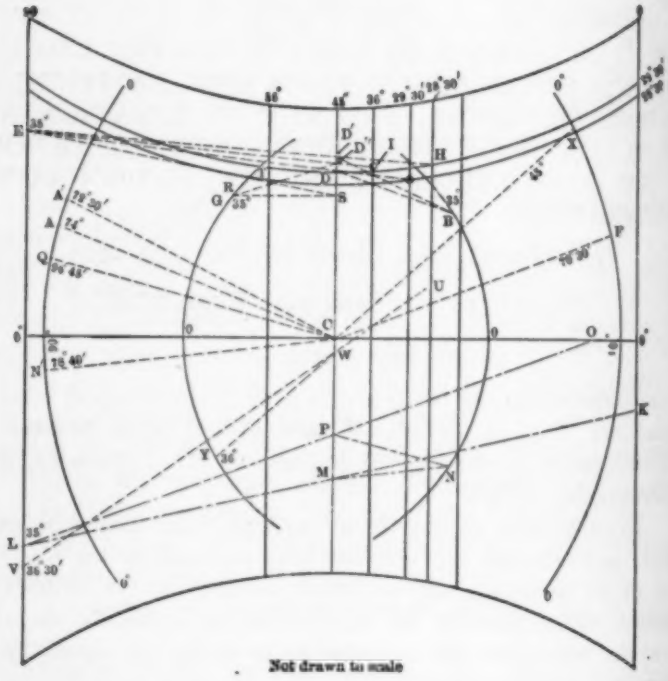
1. In addition to finding the azimuth and hour angles of known bodies as explained, this diagram may be used for the identification of an unknown star in cloudy weather by its altitude and azimuth, while most of the other problems solved in the above paper by *tri-rectangular coordinates* may also be solved by this diagram. For instance:

At sea, Feb. 26, 1901, 6.30 p. m., L. M. T., weather overcast and cloudy. Observed the altitude and azimuth of an unknown star through a break in the clouds, 29° 30′ (true), bearing N. 74° W. (true). Position by account—Lat. 35° N., Long. 60° W. What is the star? For diagram see Pilot Chart for February, 1903.

Mark the azimuth at A on the western curve, join A with the center of the diagram C. Take the latitude of the observer on the eastern latitude curve, N. 35° 00′; through this point B draw a line parallel to AC cutting the 45° altitude line in D. Take the latitude on the 90° altitude line at E and join DE. The intersec-

tion of DE with the 29° 30′ altitude line will give the declination of the body, and the hour angle is found as directed on the diagram and the right ascension by Problem I. Thus the star is found from the Nautical Almanac.

The following problems may also be solved with the aid of this diagram:



To find the altitude of a known celestial body at a given time.

Example: Find the altitude of *a* Andromedæ at 6.30 p. m., L. M. T., Feb. 26, 1901, Lat. 35° 00′ N., Long. 60° 00′ W. We find the hour angle = 4 hrs. 50 min. (W) = 72° 30′. Take A′ at 72° 30′ on western azimuth curve, join A′C. Take B at 35° N. on eastern Lat. curve. Draw BD′ parallel to CA′, take E at 35° N. on 90° altitude line, produce ED′ to intersect the 28° 30′ altitude line in H, which gives the altitude 29° 30′ on the declination curve.

To find the azimuth and hour angle at rising and setting.

Example: Find the azimuth and L. A. T. of sunset, Feb. 25,

1903, in Lat. 35° S., Dec. 9° 15′ S. Take K on 0° altitude line at 9° 15′ S., L at 35° S. on 90° altitude line, join KL, intersecting 45° altitude line in M. Take N at 35° S. on eastern curve, join MN, and through C draw CN′ parallel to MN and we find the azimuth—S. 78° 40′ W. Take O at Dec. 0° and altitude 9° 15′ join OL, cutting 45° altitude line in P, join NP, through C draw CQ parallel to NP, giving hour angle = 96° 45′ = 6 hrs. 27 min.

To find the altitude and hour angle of a body on the prime vertical.

Example: Find the altitude and hour angle of *a* Andromedæ when on the prime vertical (E), Feb. 26, 1901, in Lat. 35° N., Long. 60° W. Azimuth = 90°. Take R at 35° N. on western Lat. curve, draw RS parallel to equator (0° Lat. and Dec. line), cutting 45° altitude line in S. Join ES, cutting 28° 30′ Dec. curve in T, giving altitude 56°. Find hour angle as directed on diagram, which applied to the * R. A. gives the L. S. T., from the time of crossing the prime vertical may be found. H. A. = 40° = 2 hrs. 40 min.

To find the approximate latitude from the altitude and hour angle of a known body.

Example: In south Lat. by account, 36° 30′ the true altitude of * Castor is 10° and hour angle = 3 hrs. (E). Find the lat. Exchange values of altitude and declination and mark position of * at U. Take V at 36° 30′ on 90° altitude line. Join UV, cutting 45° altitude line in W. Take CX at 45° on azimuth curve and through W draw WY parallel to CX, giving latitude 36° 05′ S. on western latitude curve.

2. It is evident that the ordinary problems of great circle sailing may be solved by means of this diagram by shifting the parts as explained in Problem X, thus: Find the Great Circle course and distance from A in Lat. 35° N., Long. 76° 00′ W. to B, Lat. 36° 00′ N., Long. 5° 30′. With the difference of longitude as azimuth (70° 30′), mark point F. Join FC. Take G at 35° on opposite (western) latitude curve and through G draw GD parallel to CF. Take E at 35° on 90° altitude line, produce ED; the intersection of this line with the altitude line of the same degree as the latitude of the port of destination will give a declination the complement of which will be the great circle distance = 90° — 33° 50′ = 56° 10′ = 3370 miles and the corresponding hour angle will be the course from A (see Problem X above).

3. The diagram constructed by Mr. Littlehales has the advantage over the system of tri-rectangular coordinates in that a single sheet embraces all latitudes, while with the other system many sheets are required; on the other hand, the problems are more directly solved by the system of tri-rectangular coordinates in which the two unknown quantities are found simultaneously, as in identifying an unknown star and finding the great circle course and distance, while by the other method these are found independently. When the diagrams are constructed on the proper scale both methods are sufficiently accurate for all practical purposes.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

CHRONOMETER RATES.

By LIEUT.-COMMANDER E. E. HAYDEN, U. S. N.

It may be of interest to navigators to see and compare a few graphic records of the rates of chronometers as observed on land, under the uniform and favorable conditions of the Naval Observatory, and at sea, under the varying and often very unfavorable conditions of active cruising aboard different types of naval vessels. With this object in view I have tried to present in as graphic form as possible a few actual records, selected not for any especial peculiarity but rather for the completeness and evident care with which the data were observed and recorded during many long months and even years of observation. Such records must, it would seem, be of interest and value as indicating, by means of results obtained in the past, what may be expected in the future.

The new edition of Ship's Chronometer Records that has been prepared recently by the Naval Observatory and approved by the Bureau of Equipment will, it is hoped, facilitate the work of the navigator in this respect and at the same time lead to a more complete and useful series of reports on file at the Observatory regarding the performance at sea of every standard naval chronometer. Such reports serve as a basis of comparison by which to grade chronometers in classes for issue, so that it may never happen, for instance, that one ship will receive three of the very best standards and another three of the very worst, but that every ship will have a fair deal. The life of a chronometer, like that of a man, is about three score years and ten, and its official record of actual performance at sea is a matter of real importance to the service.

New chronometers submitted for trial before purchase and old standards that have been cleaned and repaired go through a long and rigid six months' trial, by means of which their rate curves and trial numbers are established. This trial is held regularly every year, from January to June, and there are usually as many as a hundred chronometers entered, of an aggregate value of about $30,000. The results determine what chronometers shall be purchased, the price, and the relative value, as determined by the rules of the trial, of all the instruments. The rules, the result of long experience of the various officers who have been in charge from time to time, undoubtedly give as good a test as can be given without the ultimate and final test of actual service. This trial is so important that I will quote here the official rules, which explain it briefly but completely. From the formulae quoted any officer can compute and plot the curves of his own chronometers, after a somewhat wide range of temperature has been experienced. To do this, take for each of the rates, a, b, c, the mean of two or three observed rates that plot close together at low, middle, and high temperatures, respectively, and for d, e, f, the means of the corresponding temperatures.

RULES OF THE NAVAL OBSERVATORY TRIAL.

1. The instruments shall be of American manufacture and only such as have the ordinary compensating balance, suitable for use on board seagoing vessels, and without auxiliary correctors, will be accepted for trial. No chronometer with palladium hairspring will be received for trial until further experience with those now in use shall have satisfied the Bureau that palladium is as reliable as steel.

2. The trial shall be as follows, chronometers entered to be subject to a test in the temperature room and to a trial of ten weeks in the chronometer room under the natural conditions of that room:

I. *Temperature-room trial.*—The range of temperature in this room will be from 90° to 50° F., the chronometers being exposed for a term of one week to each of the following temperatures in succession, viz.: 90°, 85°, 70°, 55°, 50°, 50°, 55°, 70°, 85°, and 90°, all Fahrenheit.

After the chronometers are placed in the temperature room the temperature will be raised to 90° F., and after running one day at that temperature their errors will be determined and the trial under those conditions will commence. At the end of the term, one week, the errors will be determined again, the temperature of the room will be arranged for the next term, and the instruments will be allowed to run for one day at the new temperature in order to allow them to settle to their new rates, after which their errors

will be determined and the test for the second term will commence. The tests for the other terms will follow in the same manner, all changes in temperature being made gradually. Temperatures will be verified by chronometric thermometers.

Comparisons will be taken daily with the standard mean time clock, which is rated by transit observations. The errors being determined at the beginning and the end of each term, the daily rates for the several temperatures will be deduced from them. During the temperature-room trial the relative humidity of the atmosphere will be kept as nearly as practicable at 60 per cent, as determined by sling psychrometer.

II. *Chronometer-room trial.*—After the temperature-room trial the chronometers will be placed in the chronometer room, where they will be rated for ten weeks to determine the regularity of their rates or the degree of accuracy with which they follow the curves.

III. *Polarity test.*—While in the chronometer room the chronometers will be rated for polarity of balance for one term, with the XII mark of the dial pointing east; and for the same period on each of the points west, south, and north, respectively. This test will not begin until the chronometers shall have been in the chronometer room at least one term. If this test show polarity, through acceleration or retardation of the rate, it will be repeated to establish the fact.

3. The merits of each chronometer will be determined by trial number, which shall be derived from the following formula:

$$\text{Trial No.} = p\,(70^\circ - \theta) + (10000z)^2 + 100V_0^2 + 100V''^2.$$

θ = the temperature of compensation, which is that temperature at which the chronometer runs the fastest (or, in case the chronometer is over compensated, the slowest).

The expression $(70^\circ - \theta)$ means the difference, in degrees, between 70° F. and the temperature of compensation, and this quantity is always taken with the positive sign.

z = the temperature constant, being the change of rate for a change of 1 degree in temperature from the temperature of compensation.

p = a factor depending on z for its value, and is taken by interpolation from the following table:

For $z = .00000$,	$p = .0000$
.00025	.0625
.00050	.1250
.00075	.1875
.00100	.2500
Etc.	Etc.

The temperature rate curve, showing the effect of temperature on the chronometer's rate, assuming the curve to be a perfect parabola, is computed as follows:

In the equation of a parabola ($y^2 = 4mx$), if $y = 1$, $x = \frac{1}{4m}$. Here the axis of x is the temperature of compensation, so that when $y = 1$, $x = z = \frac{1}{4m}$. Substituting we have, $x = zy^2$, or if r = rate at tem-

perature θ and r' = rate at some other temperature θ', then $x = r' - r$ and $y = \theta' - \theta$ and the equation becomes $r' = r + x(\theta' - \theta)^2$

To compute the curve three points are found from the mean temperature-room data at 55°, 70°, and 85°.

a = rate at d	d = lowest temperature = 55°	$a = r + x\,(d-\theta)^2$
b = rate at e	e = middle temperature = 70°	$b = r + x\,(e-\theta)^2$
c = rate at f	f = highest temperature = 85°	$c = r + x\,(f-\theta)^2$

From these three equations,

$$\theta = \frac{(b-c)\ (d^2-e^2) - (a-b)\ (e^2-f^2)}{2\ [\ (a-b)\ (f-e) - (b-c)\ (e-d)\ ]}$$

$$x = \frac{(a-b)}{(\theta-d)^2-(\theta-e)^2} = \frac{(b-c)}{(\theta-e)^2-(\theta-f)^2} = \frac{(c-a)}{(\theta-f)^2-(\theta-d)^2}$$

$$r = a - x\ (\theta-d)^2 = b - x\ (\theta-e)^2 = c - x\ (\theta-f)^2$$

The curve is constructed by computing the rates of the chronometer for every 5° of temperature from 90° to 50° from the formula $r' = r + x(\theta - \theta')^2$.

V represents the running in the temperature room. It is determined for each period by computing the difference between the observed rate and the curve rate at that temperature.

V_o^2 = the mean of the sums of the squares of these differences, giving those at 85°, 70°, and 55° three times the weight of those at 90° and 50°.

V' represents the running in the chronometer room. It is determined for each period by computing the difference between the observed rate and the curve rate at that temperature, finding the mean of these differences, and finally the variation between this mean and each difference. In other words, the rate curve is moved to the right or left to agree best with the rates observed in the chronometer room, and the variations from this new curve are then obtained.

V'^2_o = The mean of the sums of the squares of these variations, with equal weight.

4. No chronometer will be accepted of which the trial number is greater than 16, unless otherwise directed by the Bureau; and in no case greater than 25. No instrument found faulty in polarity of balance, and in consequence unfit for use at sea, will be accepted.

It will be seen from the above rules that trial numbers are deduced from the observed rates by means of an empiric formula intended to assign due weight to each of four qualities, of which the shape of the curve is one but not the most important. The greatest weight is given to regularity of running, or the closeness with which the curve is followed, inasmuch as both of the last two terms include it.

Plates I and II illustrate the rate curves of 42 new chronometers and the composition of 33 of their best trial numbers,

that is, the relative weight of the four quantities whose sum makes each number. These two plates are self-explanatory and need not be referred to further than to say that while such trial records are necessary and perhaps the best tests that can be devised for the purchase of new chronometers, yet I believe that service records ought to be taken more account of in determining the relative values of chronometers after they have once been purchased. Of course they have to be cleaned and repaired once every four years, but when this is done by the maker or other expert workman it need not change the essential character of the instrument, so that if it has made a first rate record on one cruise it is very likely to maintain its reputation on another. The majority of experienced navigators would prefer, I think, to have an old chronometer that they have used once and found reliable than a brand new one, no matter how small its trial number. In connection with Plate I, attention may be called to a fact that is not generally understood, namely, that even the best chronometers with steel springs and ordinary balances (which are the most reliable for use at sea) are not and cannot be compensated to run the same at all temperatures, but only to follow a certain definite curve.

Plate III gives the records of two chronometers that I rated from October, '98, to June, '99, at the Mare Island Observatory and from July to October, '99, aboard the U. S. S. Solace during a voyage from San Francisco to Manila and return. Consecutive points are joined by straight lines that might naturally be expected to be chords or short arcs of the curves and the size of each dot represents roughly the number of days rate.

It will be seen from the plate that the Mare Island data gave the lower parts of the curves very well, but that owing to the unfortunate lack of a temperature room there, it was practically impossible to predict rates upon getting in warmer weather, a fact that shows the importance of such addition to the Mare Island Observatory. The long dotted rate curves are drawn from the three points (B, C), (A, E), and (7, 8, 9, 12), the lettered rates being weighted according to the number of days represented. The short dotted curves are drawn using (B, C, D) for the upper points of each. All the data, both land and sea, are fairly consistent, except D, which is badly out. The fact that these two chronometers as well as those used by the

Navigator of the Solace were all out at D, and in the same direction, indicates a common cause; the change was possibly due to the fact that the ship went from Manila to Yokohama via Guam, involving a radical change of course from easterly to northerly and perhaps affecting the chronometers as it did the compasses. Similar cases of a common variation will be seen on some of the following plates, and the subject is one that might well repay a careful study, beginning with one's own observations and computations.

Plate IV gives the record of the three standard chronometers of the U. S. S. Brooklyn from October '99, to September, '02, during a long cruise from Hampton Roads to the Philippines, Japan, China, Australia, New Zealand, Japan, Java, England and back to New York. The usual rate curves are not drawn because none were available when the chronometers were issued, but there seems to be a decided tendency in each case toward a certain more or less definite curve. One of the reported rate intervals is very large, 119 days. Rates 24 to 29 vary decidedly in the same general direction.

Plate V, U. S. S. Nashville, December, '99 to January, '03. These three chronometers show a decided tendency to get away from their rate curves, especially the middle one, whose curve is at the extreme left hand side of the plate. A considerable and usually progressive movement of the rate curve toward the right (gaining) is to be expected in the case of new, or so-called "green" chronometers, steel hair-springs always showing this tendency to accelerate until they are well seasoned. Rates 13 to 15 and 24 to 29 indicate some common cause of variation, the lines moving in the same direction and generally across the direction of the curves. These chronometers had all been running about two years and a half when this record was commenced, and the middle one evidently needed cleaning and oiling. Such a record made by a fine chronometer is in itself a warning that it needs examination by an expert, than whom none other should ever be trusted even to look at the works.

Plate VI, U. S. S. Machias, cruise from New York to the east coast of Asia and return, October, '94, to May, '97. This plate illustrates what is probably a typical record of three good chronometers, or a fair average target made by such a battery. The first ten rates, joined by dotted lines, are those at the

Naval Observatory immediately before issue and after the trial from which the rate curves were obtained. The first chronometer shows a somewhat regular acceleration, the last a retardation, and the middle one very little of either. Rates 41 and 42 show a uniform and decided variation, an explanation of which would be of great interest if studied out by the Navigator at the time when it was noted.

It is hoped that these plates will be of interest to officers and suggestive of both the immediate and future value of such graphic records of observed rates. They may serve also as fair examples of what can be expected from Observatory rate curves and sea rates aboard our modern ships and perhaps increase interest in the keeping of good records for future comparison and publication.

APPENDIX.

The following quotations from foreign official reports are of interest in connection with precautions to be taken in transporting chronometers.

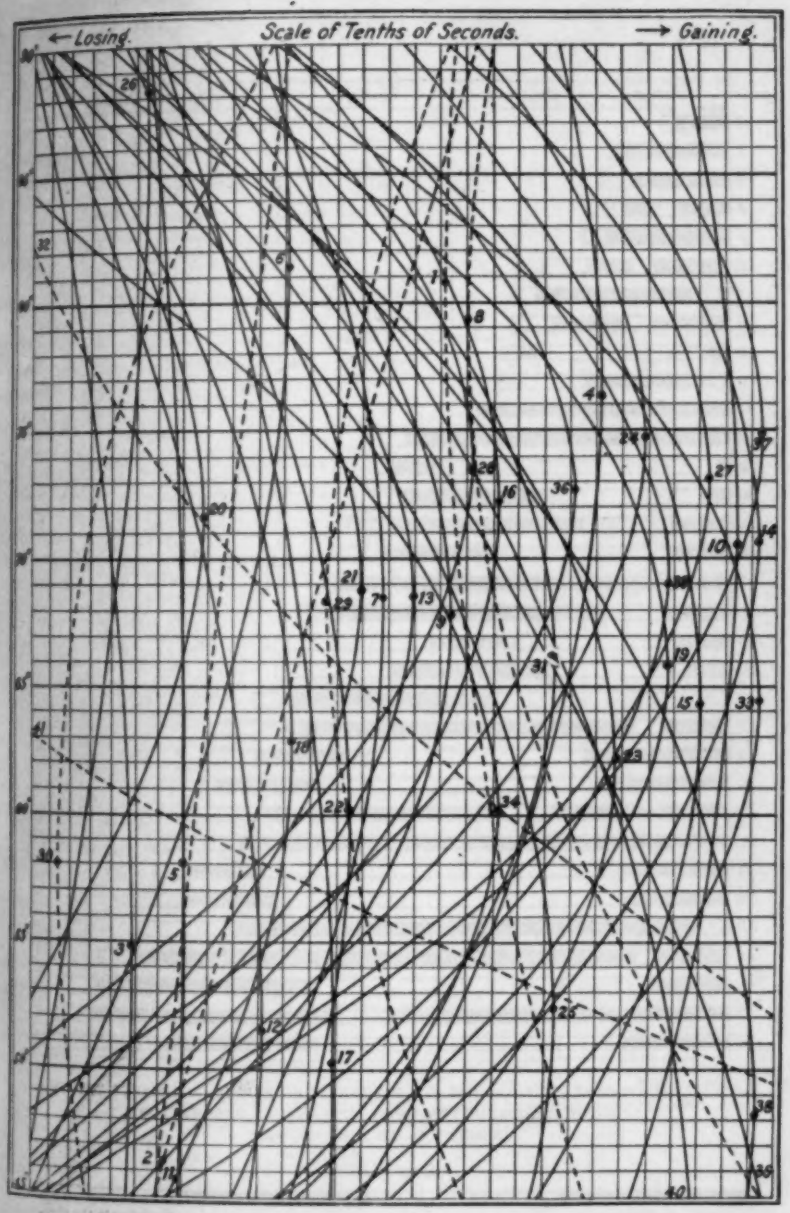
BRITISH NAVY.—A chronometer is easily stopped by a rotatory movement. This should be borne in mind when carrying to or from the depot, and the chronometer looked at on arrival to ascertain whether it is going. A chronometer should always be carried *by hand*, either in a box provided for the purpose, as kept at the chronometer depots at the home ports, or slung in a handkerchief.

FRENCH NAVY.—Transportation from the Observatory to the ship requires the greatest care and should be carried on under the eyes of the Navigating Officers. During such transportation, which ought to take place whenever possible during fine weather, the gimbals ought to be clamped, the bowls well closed and held in both hands. In this way one can avoid shocks and rotary movements.

GERMAN NAVY.—The transportation of chronometers must be confided to persons well acquainted with the peculiarities of these delicate instruments. When practicable they should be transported during dry weather and each chronometer should be placed in its transporting case. Should no transporting case be available it should be carried in a handkerchief or cloth, so that the four corners of the cloth can be tied together on top and

form a handle by which the chronometer can be carried by hand. During transportation the chronometer should be carried so that the dial shall always be horizontal. Shocks and blows must by all means be avoided, and special care shall be taken to avoid pendulum movements, especially the turning of the instrument in a horizontal plane. The latter motion is very liable to disturb the balance. An excessive motion in this respect will cause the gearing to pass over an oscillation and thus omit engaging the next tooth of the gear, thereby causing the second hand to jump a second, making two jumps instead of one. In case of such an excessive oscillation the balance will not immediately resume normal oscillation but will have a tendency to repeat the excessive jumps. This action will not only affect the rate of the chronometer but will essentially change the action of the spiral hair-spring. Sometimes such an excessive oscillation will even break the hair-spring. On the other hand, in case of horizontal motion the oscillation period may be changed to such an extent as to cause the chronometer to stop. From this we have the rule never to turn a chronometer through 360° in less than ten seconds.

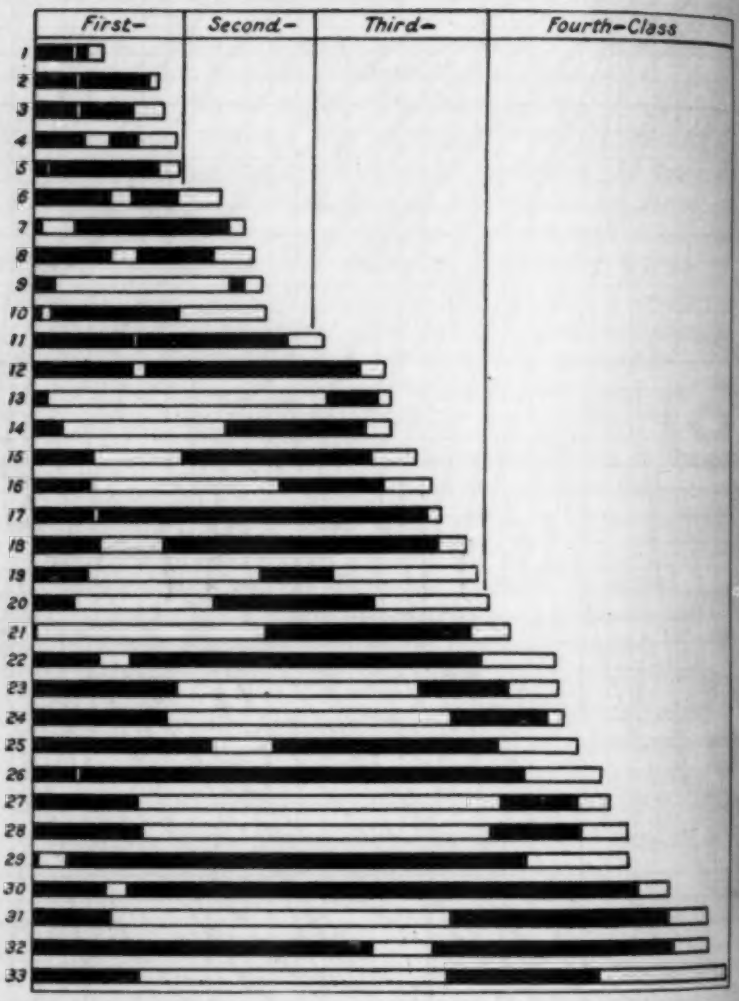
ITALIAN NAVY.—Every chronometer must be carried in its case suspended by a strap and in charge of a person well acquainted with the delicate character of the instrument. Vibrations, and most especially horizontal oscillations, must be avoided, to prevent any disturbance of the balance and stopping of the instrument. Whenever transported in a boat or a carriage the chronometer must be carried by hand during the entire time. When a chronometer is taken from ship ashore it should be under the special charge of the Navigator, and must be carried in the hand by a careful, competent person.



TEMPERATURE RATE CURVES, CHRONOMETER TRIAL, U. S. NAVAL OBSERVATORY, JANUARY 14 TO JUNE 30, 1902.

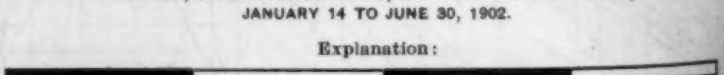
The numbers, in order of merit of the chronometers in the entire trial, are placed at the point on the curve indicating the temperature of compensation, when that point falls within the limits of the diagram. The dotted curves indicate overcompensation.

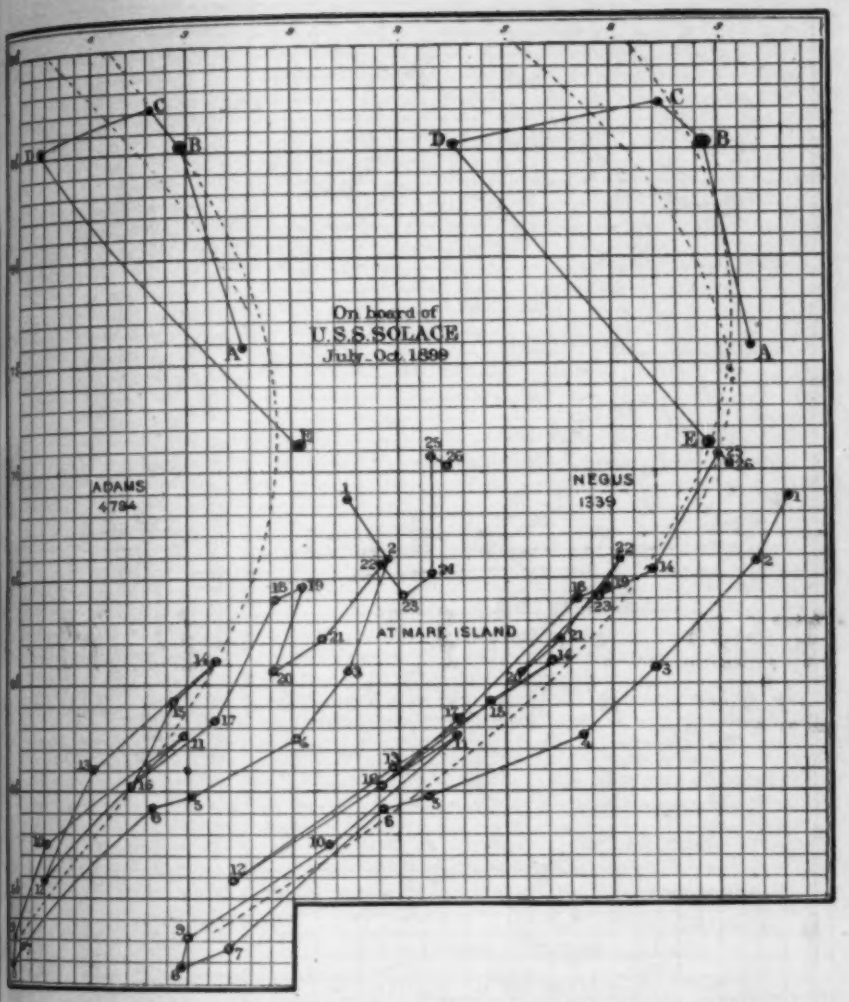
PLATE II.



GRAPHIC REPRESENTATION OF THE FOUR QUANTITIES WHOSE SUM MAKES THE TRIAL NUMBER, CHRONOMETER TRIAL, U. S. NAVAL OBSERVATORY, JANUARY 14 TO JUNE 30, 1902.

Explanation:



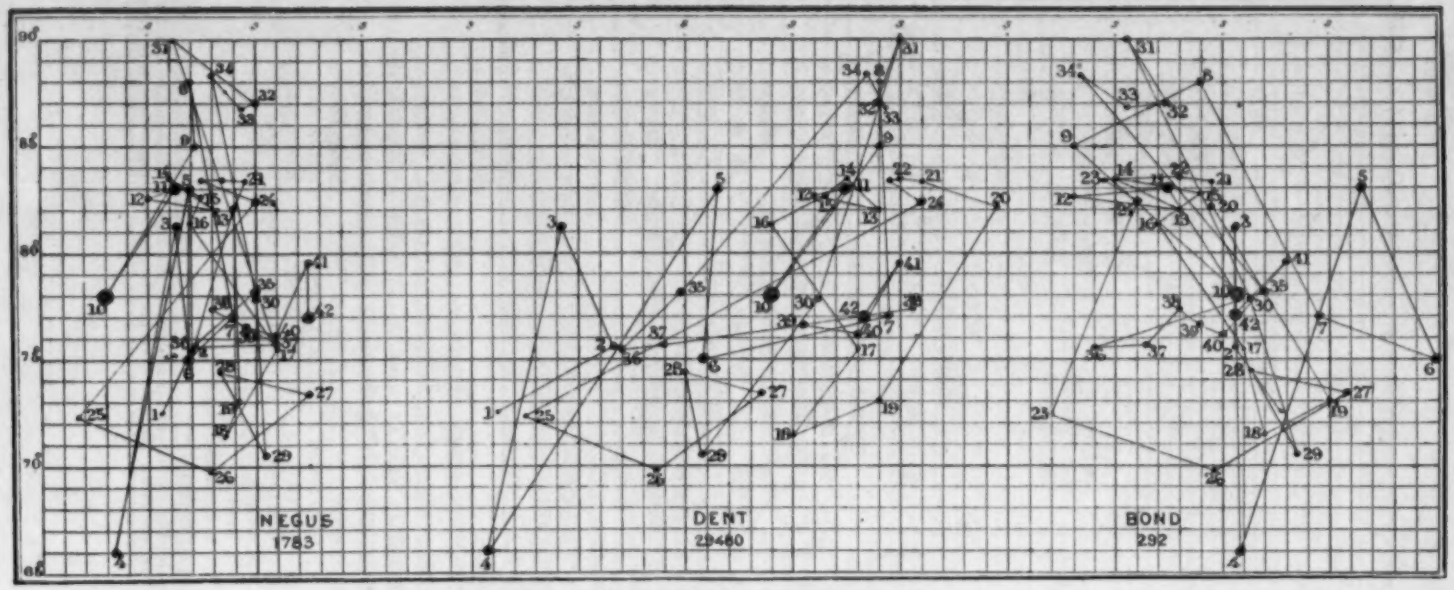


CHRONOMETER RATES ASHORE AND AT SEA, AT MARE ISLAND OBSERVATORY AND ABOARD U. S. S. SOLACE.

Obs. No.	No. of Days.	Position.	Adams 4794.	Negus 1339.
1 to 8	10 each	Mare Island	XII North	XII South
9 to 24	"	"	XII South	XII North
A	10	Honolulu	XII toward bow of Solace	
B	30	Manila	"	"
C	10	Manila	"	"
D	18	Yokohama	"	"
E	21	San Francisco	"	"

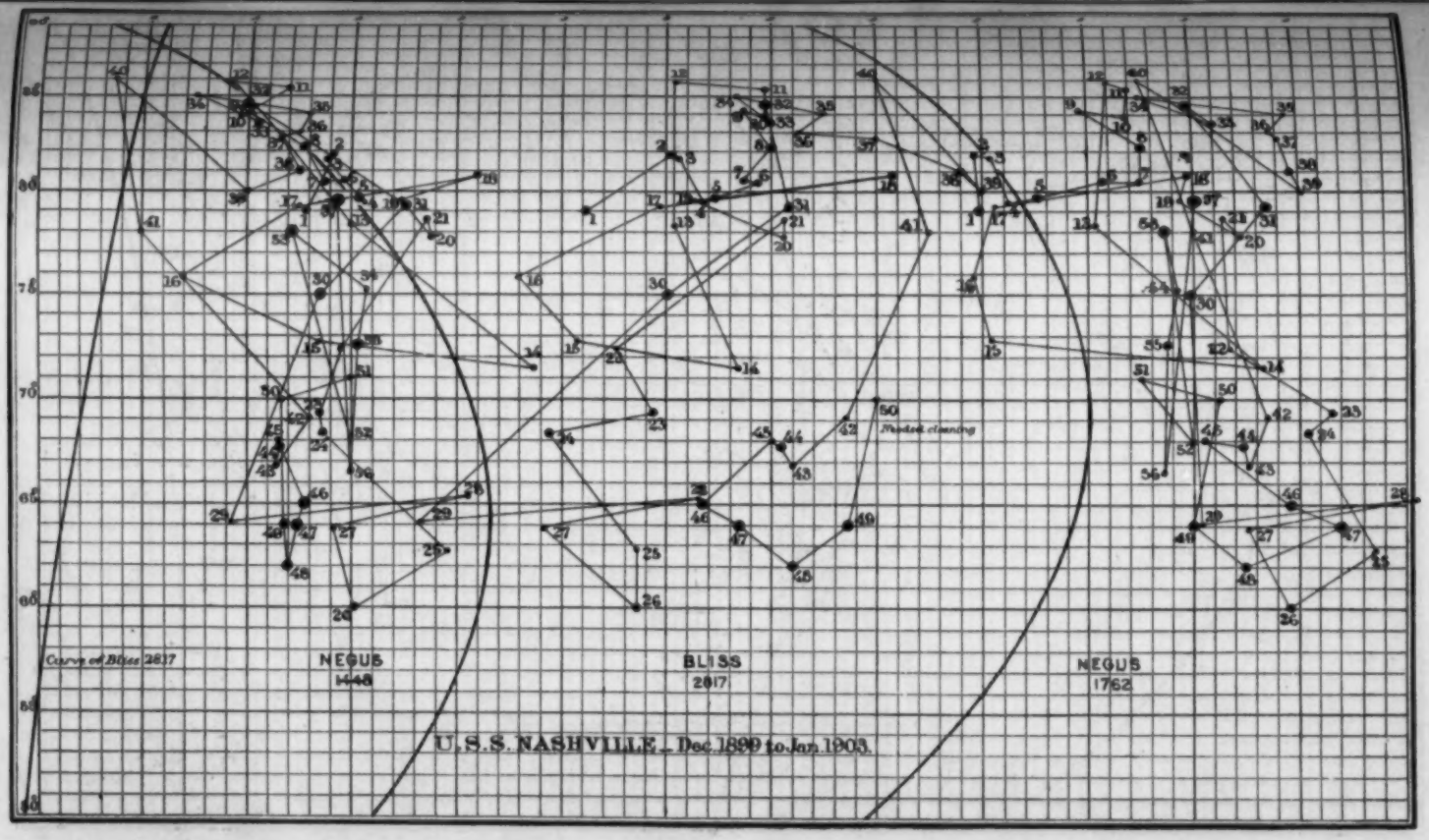
NOTE.—The rate scale at top is tenths of seconds, gaining to the right and losing to the left. The temperature scale at left is degrees Fahr. Consecutive points representing mean daily rates are joined by straight lines. The size of each point is roughly proportional to the number of days in that rate period.

PLATE IV.



U. S. S. BROOKLYN, OCTOBER, 1899, TO SEPTEMBER, 1902.

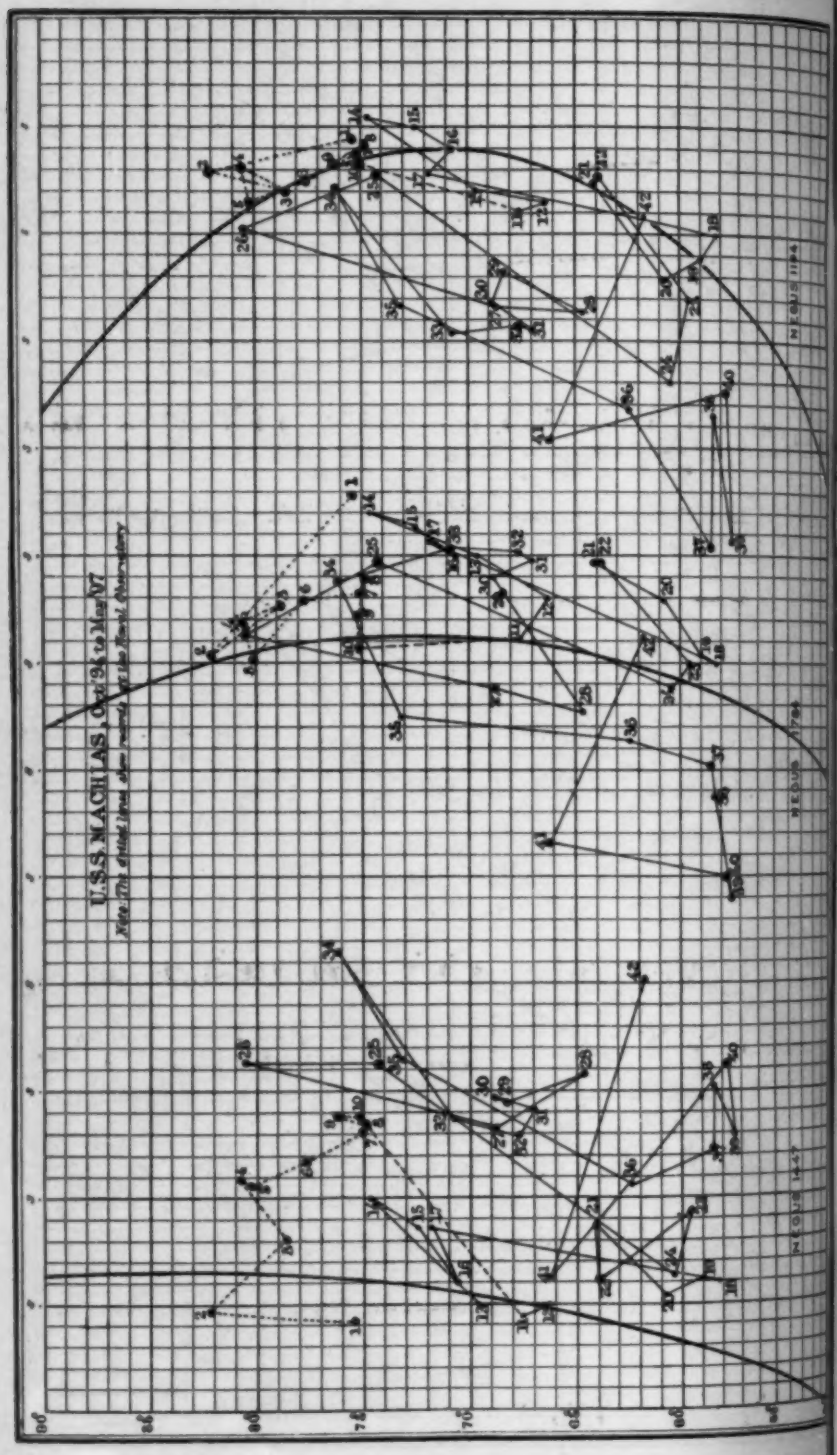
Obs. No.	Position.	No. of Days.	Obs. No.	Position.	No. of Days.	Obs. No.	Position.	No. of Days.	Obs. No.	Position.	No. of Days.	Obs. No.	Position.	No. of Days.	Obs. No.	Position.	No. of Days.
1	Fort Monroe	7	8	Manila	14	15	Manila	10	22	Manila	10	29	Sydney	20	36	Yokohama	17
2	Port Said	25	9	Hong Kong	22	16	do.	10	23	do.	10	30	Batavia	28	37	do.	21
3	Manila	42	10	Shanghai	119	17	Hong Kong	7	24	Sydney	19	31	Manila	9	38	Kobe	9
4	Hong Kong	48	11	Manila	45	18	do.	10	25	Melbourne	6	32	do.	20	39	Shanghai	29
5	Manila	24	12	do.	10	19	Manila	10	26	do.	14	33	do.	12	40	Hong Kong	23
6	Yokohama	42	13	do.	20	20	do.	10	27	Wellington	20	34	do.	12	41	Southampton	22
7	Hong Kong	98	14	do.	25	21	do.	10	28	Sydney	9	35	Vladivostock	25	42	New York	22



U.S.S. NASHVILLE - Dec. 1899 to Jan. 1903.

PLATE V.

PLATE VI.


U.S.S. MACHIAS, Oct. 9th to Mar. 17
Note: The dotted lines show results of the Naval Observatory
NEGUS 1184
NEGUS 1784
NEGUS 1427

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

RANGE FINDING IN THE NAVY.

By JOHN F. MEIGS, of the Bethlehem Steel Company.

The most recent guns of medium and large size are independent of the ascertainment of the range up to distances of from 1500 to 2000 yards. Existing plans of range finding give doubtful results at 2000 yards, and it is not too much to say that under any except the most advantageous circumstances they fail entirely at 3000 yards. Thus naval guns between the ranges of 2500 or 3000 up to 8000 yards, up to which limit they are able to go, are without a means of finding the range. Of course a battery of guns thoroughly in control, and where other circumstances are favorable, may set their sight bars and direct their fire by observation of the flight and fall of projectiles, but practical officers regard this method as being difficult of accomplishment, and under many circumstances impossible. No one will deny that the ascertainment of the distance of a target by instrumental means, other than the flight and fall of projectiles, would be of advantage. The writer believes that the range can probably be found by the method here given, and at all events, that the method is worthy of a trial. It consists simply in the use of instruments in two ships, the distance between these instruments constituting the base line of the triangle to be solved. This triangle is solved by mechanical means, with sufficient accuracy, and the range is read off a moving tape and would be communicated thence to the guns. Figures I and II will show the operation of the instrument. In each the small triangle A_1-B_1-C_1 is in miniature the triangle defined by the two range-finding ships and the target, as indicated in Fig. I.

The instruments are the same in all ships, and their character

is seen at once from Fig. II. The beam A_1-C_1, on which a telescope is mounted, is, by means of the cross hairs in the telescope and the hand wheel O, kept directed at the target. The azimuth of this beam, by means of the circle on which it swings and the quick-reading dial D, reading to minutes, is communicated to the other ship. This ship sets its beam B_1-C_1, by means of the graduations shown, and the quick-reading dial D and the hand wheel at 2, parallel to the beam A_1-C_1 of the other ship. This operation being mutually carried out between the

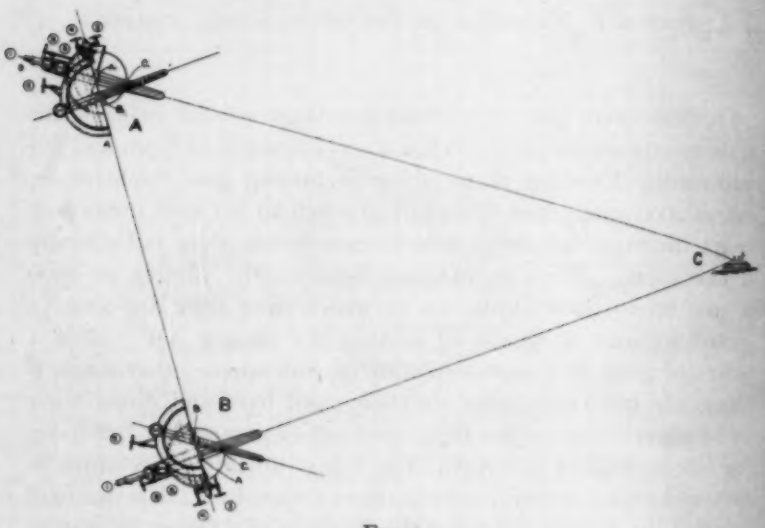


FIG. 1.

two ships, it is obvious that in each there will be the miniature triangles A_1-B_1-C_1, each similar and proportional to the triangle containing the two range-finding ships and the target.

This requires, however, that the distance apart of the centers A_1 and B_1 of the beams A_1-B_1 and B_1-C_1 shall be proportional to the distance between the range-finding ships. This is effected by means of an observer who looks through the small telescope T at the distant ship, measuring her distance, by optical arrangements in the telescope, in connection with the height of known objects in her, and directs the edge of the table of the instrument to the distant ship, while the two graduated half circles are moved by the hand wheel at 4 until the distance A_1-

B_1 is correct. The distance or length of base line is read in the two windows shown in the upper half circle.

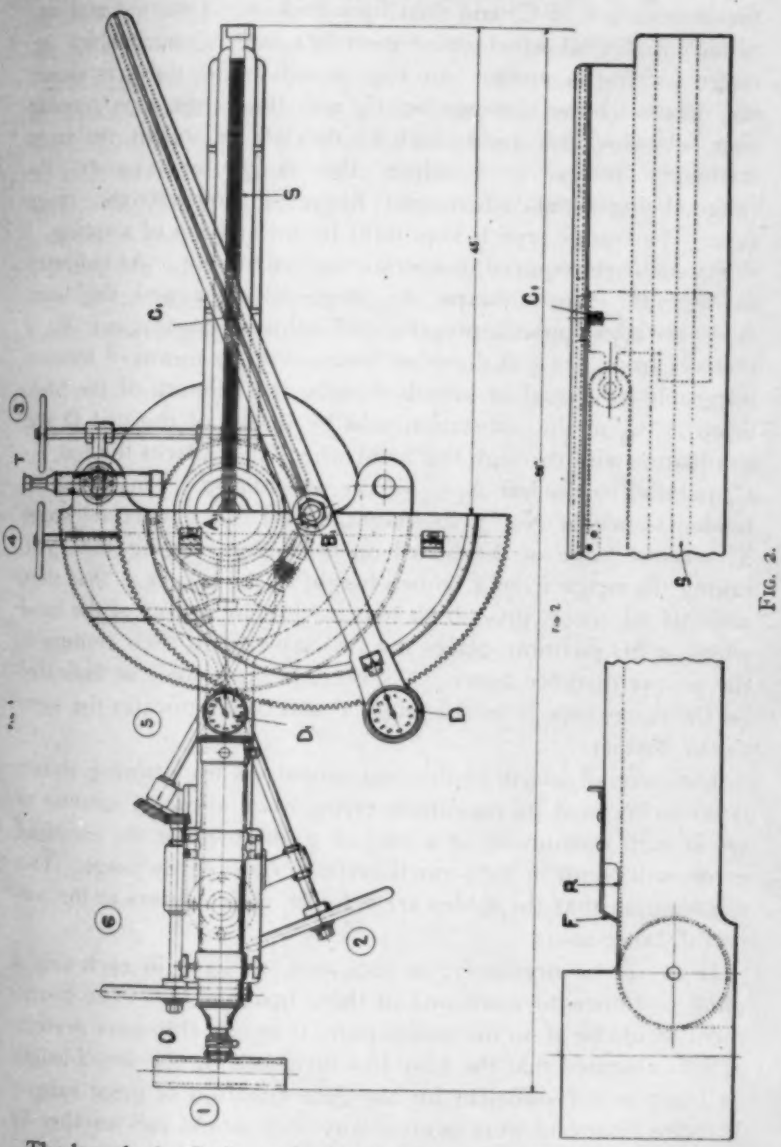


FIG. 2.

The length A_1-C_1 in each ship being proportional to the range of the target at that ship, it is only necessary to read this distance.

This is accomplished by means of a tape, one end of which is fast at A_1, and which passes forward over a pulley attached to the moving nut at C_1 and then back and over a second and stationary pulley, at which point there is a finger, under which the range reading is visible. In Fig. 2 and to the right, is shown the details of the moving nut C_1 and the range tape running over a pulley fast to it, and to the left is shown the large stationary pulley, over which the range tape passes, the range being read where the finger F touches the range tape. The range tape is kept tight by the tension of a spring.

Six men are required to operate the instrument. As indicated in Fig. II. No. 1 keeps the large telescope and the beam A_1-C_1 directed upon a prearranged point of the target. No. 2 receives from No. 5 at the other instrument, by means of wireless telegraphy or visual or sounds signals, the azimuth of the main beam A_1-C_1 at the out-station, and by means of the dial D and graduation and through the hand wheel at 2, places the bar B_1-C_1 parallel to the bar A_1-C_1 of the out-station. This being attended to whilst No. 3, looking through the smaller telescope T, sets the edge of the board on the other ranging ship, and, taking the range from a known height of the object in that ship, with his telescope, gives it to No. 4. He, by means of the hand wheel at his position, places the two tables with their centers at the proper distance apart. No. 6 reads the ranges as indicated on the range tape R by the finger F and communicates the same to the battery.

The over-all length of this instrument, as the drawing shows, is 80 inches, and its maximum error, if we allow 15 minutes of arc at each instrument, or a total of 30 minutes for the combined error, will result in 52½ yards error at 6000 yards range. This is assuming that the tables are set with their centers at the correct distance apart.

It would be necessary, as indicated, to have in each ship a gang of 6 men to work one of these instruments. The instrument would be of no use unless more than one ship were present, as it is assumed that the base line furnished by the ship's length or beam is not sufficient for the determination of great ranges. If more than one were present any ship would call another by means of wireless telegraphy or visual or sound signals, and by prearrangement, each ship would turn the small telescope T on

a specific point of its consort, and would establish the points A_2-B_1 at a proper distance apart, by means of the hand wheel at 4. The arms A_1-C_1 and B_1-C_1 being placed as indicated above, the point C_1 would move backwards and forwards and the range would show to No. 6, who would communicate it to the battery. It would appear that there is no insuperable obstacle to the working of such a plan, and if such be the fact, the range could be ascertained with reasonable accuracy up to 8000 or 10,000 yards, which is far in excess of the possibilities with instruments situated in one ship.

Finally, it may be noted that the operation of this instrument is entirely *continuous*, that is, it exhibits the range at all times, which means that no time is lost by instrumental delays.

PROFESSIONAL NOTES.

Prepared by Professor PHILIP R. ALGER, U. S. Navy.

SHIPS OF WAR, BUDGETS AND PERSONNEL.

ARGENTINA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Armored Cruisers.			
Rivadavia	7,600	Genoa.	Under trial.
Moreno	7,600	"	Launched Feb. 9, 1903.

AUSTRIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Erzherzog-Karl	10,600	Trieste.	To be launched Oct. 4.
B (ersatz-Drache)	10,600	"	Building.
C	10,600	"	To be laid down 1903.
Babenburg	8,340	Pola.	Launched Oct., 1902.
Armored Cruiser.			
E (ersatz-Radetsky)	7,400	Pola.	Building.
River Monitors.			
Save	450	Neupesth.	Nearly ready to be launched.
Theiss	450	"	" " " "

The Austrian battleship "A" of 10,300 tons is to be launched, according to *Donzer's Armee Zeitung*, on October 4, at the Stabilmento Tecnico at Trieste. She displaces 10,600 tons, and is 390 feet 6 inches long, with 72 feet 3 inches beam, and 24 feet 6 inches draught. She will be protected by an 8¼-inch belt of Krupp steel, 5-inch battery plating, 8-inch bulkheads, a 2-inch deck, and 9 and 8 inches of Krupp steel for the main and secondary guns. The armament will consist of four 9.4-inch, eight 7.5-inch, six 6-inch, and twenty-eight smaller guns. Engines of 14,000 horsepower, supplied by Yarrow boilers, are to give a speed of nineteen knots. The vessel will receive the name of Erzherzog-Karl.—*Army and Navy Gazette.*

Donzer's Armee Zeitung publishes a despondent article upon the Austrian navy in the form of a comment upon some remarks of the *Grazer Tagespost*. The navy consists at the present time of one second-class battleship and three of the third class, a second-class armored cruiser, and one of the third class, two old ironclads, three weak torpedo cruisers, seven despatch vessels, and six torpedo boats. All the others in the list have no greater value than old iron, and the Austrian navy is actually weaker than those of Chili, the Argentine Republic, or Spain. Here is certainly some exaggeration; but the critic is right in the main, and he deplores that no one in Austria recognizes the reality of the situation. The delegations of the two Parliaments have adjourned the laying down

of a third battleship of 10,600 tons, which can only be begun in 1904, for completion in 1910, by which time several of the older ships will have become ineffective. The *Armee Zeitung* quotes the remark of Captain Wislicenus in the German *Tag* that to-day, thirty-seven years after the battle of Lissa, the Austro-Hungarian fleet is scarcely equal to one-half of the Italian fleet; it has not a third of the power of that fleet, and in no way presents the type of a modern navy. This is the fruit of the negligence of many years, and the fleet is perfectly incapable of fulfilling its mission, which is the domination of the Adriatic. We quote these remarks as containing a considerable element of truth, while we fully recognize that the Austrian navy, as at present constituted, is both efficient and progressive. More money is required to make it what it ought to be.—*Army and Navy Gazette.*

CHILI.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Libertad	11,800	Barrow.	Launched Jan. 15, 1903.
Constitucion	11,800	Elswick.	Launched Jan. 13, 1903.

DENMARK.

The Danish coast defense ship Olfert Fischer, a sister of the Herluf Trolle (3470 tons), has been launched at Copenhagen. The ship is protected by Creuzot steel 8 inches thick, reducing to 4 inches, and the side above the belt has 7-inch steel. There are two 9.4-inch guns, each in a turret protected by 6-inch steel, and four 5.9-inch guns in a casemate, as well as a light armament. Her speed is to be sixteen knots.

FRANCE.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
République	14,865	Brest.	Launched Sept., 1902.
Démocratie	14,865	"	Building.
Patrie	14,865	La Seyne.	"
Justice	14,865	"	Ordered.
Vérité	14,865	Bordeaux.	"
Liberté	14,865	St. Nazaire.	"
Suffren	12,728	....	Under trial.
Henri IV	8,948	....	" "
Armored Cruisers.			
Ernest Rénan	13,562	Brest.	Building.
Jules Michelet	12,550	Lorient.	"
Jules Ferry	12,550	Cherbourg.	Launched Aug. 23, 1902.
Victor Hugo	12,550	Lorient.	Building.
Léon Gambetta	12,550	Brest.	Lchd. Oct., 1901; com. 1902.
Gloire	10,014	Lorient.	Lchd. 1900; complete 1903.
Amiral Aube	10,014	St. Nazaire.	Under trial.
Sully	10,014	La Seyne.	" "
Condé	10,014	Lorient.	" "
Gueydan	9,516	....	" "
Dupetit Thouars	9,516	Toulon.	Lchd. July, 1901; com. 1902.
Desaix	7,700	....	Under trial.
Dupleix	7,700	....	" "
Kléber	7,700	....	" "

THE FRENCH NAVY.—The number of new vessels to be laid down for the French navy in 1904 is 70, but 50 of this imposing total is represented

by torpedo boats. All these latter are to be built by private firms. On the other hand, 16 more submarines are to be built in the French Government arsenals, with the view, no doubt, of insuring secrecy as to their details. One armored cruiser is to be laid down at Brest; she will be a sister ship to the Ernest Rénan, and will have a displacement of 13,644 tons. She will be 523 feet 4 inches long by 71 feet 2 inches beam, and she will be fitted with vertical triple-expansion engines, supplied with steam from water-tube boilers, working up to 36,000 horsepower and driving three screws. The speed anticipated is 23 knots. Two torpedo boat destroyers, which are to be built at Rochefort, are to be of the Stylet type. The Stylet, it may be noted, was to have been begun in May, 1902, but she has actually only been commenced this year. She will have a displacement of 335 tons. She will be fitted with vertical triple-expansion engines working up to 7200 horsepower, supplied with steam from water-tube boilers, and driving two screws. Her maximum speed is to be 30 knots. She will cost 68,558 *l.* Of the torpedo boats proposed to be built in 1904, one is to be constructed at Saigon. Each torpedo boat is to be 126 feet 8 inches in length by 14 feet 1 inch beam, and will be fitted with a vertical triple-expansion engine supplied with steam from water-tube boilers, and working a single screw. Each boat is to steam at the rate of 26 knots. The armament of each boat is to be two guns and three torpedo tubes.—*Engineering.*

Progress on the armored cruiser Léon Gambetta, at Brest, has been rapid. All her three screws are now in position, and some of the armor, including that for the conning tower, has been fixed in her. The foremast has been stepped.—*Page's Magazine.*

New Cruiser.—The first-class cruiser Jules Michelet, of the Léon Gambetta class, has just been commenced at Lorient. Others of this class are approaching completion, and the delay in laying down the Jules Michelet is due to alterations in her design; her displacement has been increased 20 tons, and the power of her engines by 1500 H. P. The armament has also been changed, and she is to carry two 240-mm. (9.4 inch) guns instead of one 194-mm. (7.6-inch) gun, and twelve 164-mm. guns in lieu of sixteen. She is to be ready for her trials in April, 1906, and for commissioning in January, 1907.

Gun Trials on Board the Henri IV.—Some gun trials have recently taken place on board the battleship Henri IV to ascertain whether the firing of the 138-mm. (5.4-inch) gun in the upper turret would injuriously affect the crews of the 274-mm. (10.8-inch) guns in the lower turret. For the occasion some sheep were placed in the lower turret, and after the firing the animals were found in a dazed and stupefied condition; two were slaughtered, and a post-mortem examination showed that the heart of one and the brain of the other were seriously affected. Further trials are to take place, but it is said that the committee have reported adversely against the present arrangement of the turrets.

Submarine Boats.—The submarines Korrigan and Farfardet, of the Rochefort Défense Mobile, concluded a series of manœuvres by attacking the 2nd Division of the Northern Squadron off the Ile de Ré, consisting of the Bouvines, Valmy, Amiral Tréhouart, and Dupuy de Lôme. The attack is said to have been successful, the leading ships having been torpedoed.

The submarines Gnome and Lutin, now undergoing their trials, are to be attached to the Rochefort Défense Mobile, the commander of which is said to be a most successful expert with submarines.

Some particulars of the new submarine boats laid down last year have been published, which are known as "X," "Y" and "Z," and have been designed respectively by MM. Romazzotti, Bertin and Maugas. "Y" is

expected to be completed this year, and "X" and "Z" in 1904. "X" displaces 168 tons, and is 121 feet 6 inches long, with 10 feet 6 inches beam, and a draught of 7 feet 6 inches when navigating on the surface. She is provided with two screws, and is propelled by electricity. The intended speed is given as 10½ knots. "Y" is larger, displacing 213 tons, and is 142 feet 8 inches long, with 9 feet 9 inches beam. She has but one screw, and the speed is to be 11 knots. "Z" has a displacement of 202 tons, with 135 feet 8 inches length and 9 feet 8 inches beam, and a speed also of 11 knots. Two large submersibles, the Aigrette and Cigogne, have been laid down at Toulon. They will have a displacement of 172 tons, will be 117 feet 6 inches long, with a beam of 12 feet 6 inches, and 8 feet 6 inches draught.—*Royal United Service Institution.*

The *Petit Var* states that the two submersibles Korrigan and Farfadet reached Bizerta on August 15 almost unobserved. They steamed at full speed through the canal, and anchored in Ponty Bay awaiting permanent moorings to be assigned them at Sidi Abdallah. The two boats behaved admirably on their voyage from Rochefort. In passing along the Portuguese coast they had to weather a strong gale from the north, bringing a heavy sea with waves to the height of 16 feet or 17 feet. Once through the Straits of Gibraltar they encountered splendid weather, and they were able to cover the distance from Algiers to Bizerta in 48 hours.

STEAM TRIALS.—The new second-class battleship Henri IV is continuing her trials at Cherbourg. A recent trial for 24 hours, at 6103 I. H. P., was on the whole satisfactory, though the engines do not yet seem to work quite smoothly. During the first six hours the coal consumption was 67.95 kg (149.76 lbs.) per square metre of grate per hour, and 745 gr. (1.49 lbs.) per H. P. per hour; during the whole 24 hours the expenditure was 782 gr. (1.56 lbs.) per H. P. per hour. The total grate surface is, according to the contract, 75 square metres, and of the heating surface, 2409.65 square metres. The new first-class armored cruiser Amiral Gueydon, having had her bilge keels shortened, and some other modifications carried into effect, has resumed her trials. During a run of three hours at full speed, although the steam pressure fell from 18 kg. (39.67 lbs.) to 16 kg. (35.26 lbs.), in consequence of the bad quality of the coal, and it was thus impossible to develop the 19,600 I. H. P., which should have been done, 17,500 being the maximum H. P. reached, yet a speed of 21.04 knots, which is slightly over the contract, was maintained, as against 20.34 knots, which was the most attained at the trial in December last, when the engines developed their full H. P.

The new armored first-class cruiser Jeanne d'Arc, having made good some slight defects, left Toulon on the 20th Aug. for Brest, where she arrived on the forenoon of the 25th Aug. Rear-Admiral Bugard, who commands the cruiser division of the Northern Squadron, is to transfer his flag to her from the armored cruiser Bruix, which ship will then be paid out of commission into the Reserve, part of her crew being transferred to the Jeanne d'Arc to bring her up to her full complement. Sundry alterations have still to be made before the ship is ready for her new duties, and her propellers are also to be changed as soon as the new ones, which are being made for her by the Indret Firm, are ready, for though the I. H. P. developed by her engines has exceeded the contract, the estimated speed has not been realized.

INTERPRETERS.—A decree has been published, establishing the position of officer interpreters in the French navy, open to officers of all branches, executive, engineer, medical, and paymaster. A limited number of officers will be permitted to reside abroad for study, for periods not exceeding one year. While so residing, they will receive a special rate of pay, and their travelling expenses will be defrayed. On returning to

France, they will be examined in the language they have taken up, and, if successful, will be appointed interpreters. They will also be required to submit to the Minister of Marine an original essay concerning the country in which they have been residing, and a gold medal and prize of 300 francs will be given to the author of the best production.—*Royal United Service Institution.*

GERMANY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Mecklenburg	11,900	Stettin.	Under trial.
Schwaben	11,900	Wilhelmshavn.	Lchd. Aug., 1901; compl. 1903.
Braunschweig	13,200	Kiel.	Lchd; complete in 1904.
Hessa	13,200	Dantzic.	" May 26, 1903.
I	13,200	Stettin.	Building. To be compl. 1905.
Hessen	13,200	Kiel.	Lchd. Sept. 18, 1903.
Lothringin	13,200	Dantzic.	Building.
I	13,200	Gaarden.	"
Armored Cruisers.			
Prinz Heinrich	8,868	Kiel.	Under trial.
Prinz Adalbert	9,050	"	" "
Prinz Friedrich Karl	9,050	Hamburg.	Launched June, 1902.
Roon	9,050	Kiel.	Launched June 27, 1903.
I (ersatz-Deutschland)	9,050	Hamburg.	Building.
I	9,050	Kiel.	"
Protected Cruisers.			
Frauenlob	2,715	Bremen.	Under trial.
Arcona	2,715	"	" "
Undine	2,715	Kiel.	Lchd. Dec., 1902; compl. 1903.
Hamburg	3,000	Stettin.	Lchd. July 25, 1903.
Bremen	3,000	Bremen.	Lchd. July 9, 1903.
Berlin	3,000	"	Lchd. Sept. 22, 1903.

The battleship Schwaben, the last of the Wittelsbach class, is now in dry dock, preparing for her trials. If this ship does as well as her sisters have done, the class as a whole will be very satisfactory. The Wettin was the most successful, attaining a speed of 18.125, with engines developing 15,500 H. P.

Only one launch of importance took place during June from the German shipyards. This was at Kiel, where the cruiser Roon, hitherto known as the Ersatz Kaiser, was launched in the presence of the German Emperor and the royal family. The vessel is named after the Prussian War Minister, Count von Roon, and Count Waldersee performed the naming ceremony. The Roon is of the same type as the Prinz Adalbert, slightly modified. She is 403 feet in length, with a 66-foot beam, and displaces 9500 tons. The propellers are of the three-screw type, and the anticipated speed is from 21 to 22 knots. Her guns consist of four 8.2-inch quick-firers, mounted in pairs in barbettes; four 5.9-inch guns mounted in casemates, twelve 3.4-inch and fourteen smaller pieces. She is also provided with four torpedo tubes. A sister ship, known at present as the Ersatz Deutschland, is building by Blohm & Voss, at Hamburg.—*Page's Magazine.*

The Roon is the first vessel in the German navy to carry four smoke stacks behind each other.

GREAT BRITAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
A	18,000	To be laid down this year.	
B	18,000	" " " " "	
C	18,000	" " " " "	
Hindostan	16,350	Clydebank.	Building.
New Zealand	16,350	Portsmouth.	"
Commonwealth	16,350	Glasgow.	Launched May 13, 1902.
Dominion	16,350	London.	Launched Aug. 25, 1902.
King Edward VII	16,350	Devonport.	Launched July 22, 1902.
Queen	15,000	"	Launched March, 1902.
Prince of Wales	15,000	Chatham.	" May, 1902.
Armored Cruisers.			
Duke of Edinburgh	13,500	Pembroke.	Building.
Black Prince	13,500	Blackwall.	"
3	13,500	Pembroke.	"
4	13,500	.....	Projected.
5	13,500	.....	"
6	13,500	.....	"
Hampshire	10,700	Elswick.	Building.
Devonshire	10,700	Chatham.	"
Roxburgh	10,700	Glasgow.	"
Antrim	10,700	Clydebank.	"
Argyll	10,700	Greenock.	"
Carnarvon	10,700	Glasgow.	"
Monmouth	9,800	Govan { London & Glasgow Co.	Under trial.
Cornwall	9,800	Pembroke.	Launched Oct., 1902.
Suffolk	9,800	Portsmouth.	" Jan., 1903.
Cumberland	9,800	Govan { London & Glasgow Co.	" Dec., 1902.
Lancaster	9,800	Elswick.	Under trial.
Protected Cruisers.			
Challenger	5,880	Chatham.	Under trial
Encounter	5,880	Devonport.	Launched June, 1902.
Topaz	3,000	Birkenhead (Laird).	" July 23, 1903.
Amethyst	3,000	Elswick (Armstrong).	Building. (To have Parsons turbines.)
Diamond	3,000	Birkenhead (Laird).	Building.
Sapphire	3,000	Yarrow (Palmer).	"
Gunboats.			
Cadmus	1,096	Sheerness.	Launched April 29.
Clio	1,096	"	Launched.
Scouts.			
Adventure	2,750	Elswick.	Building.
Forward	2,845	Fairfield.	"
Pathfinder	2,610	Birkenhead.	"
Sentinel	2,900	Vickers.	"
5	2,800	"	"
6	2,800	Fairfield.	"
7	2,800	Elswick.	"
8	2,800	Birkenhead.	"

The Princess of Wales visited Devonport on Thursday, July 23, and launched the first-class barbette battleship King Edward VII. from the Royal Dockyard. The King Edward VII. is one of a class of five battleships designed by Sir William H. White, formerly Assistant Controller

of the Navy and Director of Naval Construction. The following are the principal dimensions of the King Edward VII.: Length between perpendiculars, 425 feet; breadth extreme, 78 feet; load draught of water forward, 26 feet 3 inches; aft, 27 feet 3 inches; load displacement, 16,350 tons; indicated horsepower (estimated), 18,000; speed with full power, 18½ knots. Her engines, which have been made by Messrs. Harland and Wolff, Belfast, consist of two independent sets of vertical triple-expansion engines, each having four cylinders; each set is capable of developing 9000 horsepower with 120 revolutions per minute. She will have fourteen separate water-tube boilers of the Babcock and Wilcox type, and six separate cylindrical boilers, each capable of being used independently of the others. The armament will be as follows: Four 12-inch breech-loading guns, working in two barbettes; four 9.2-inch breech-loading guns, worked in four barbettes; ten 6-inch quick-firing guns, worked in battery; twelve 12-pounder 12 cwt. quick-firing guns; two 12-pounder 8 cwt. quick-firing guns; fourteen 3-pounder quick-firing guns; two .303 Maxim guns; and four submerged torpedo tubes. She will have a complement of 777 officers and men. The first keel-plate of the ship was laid on March 8, 1902, by the King, after the Queen had named the battleship Queen. The King Edward VII. has been under construction 16½ months, and is in a very advanced stage, about 6100 tons of material having been worked into her, including 675 tons of armor.—*Engineering.*

The Admiralty are hesitating about proceeding further with their plans for a new class of battleship, designed by the new Chief Constructor, of 18,000 tons displacement. It is felt that warships with a beam of 80 feet and upwards will be difficult to dock in many ports throughout the British dominions, and it is now proposed to adhere to the size of the King Edward VII. class, which have a displacement of 15,000 tons and a width of 78 feet 6 inches. Three of this type of ships are now building—the King Edward VII., the Dominion and the Commonwealth. —*Iron Age.*

The Admiralty have issued specifications for three armored cruisers, to be built in private yards, and machinery for a fourth, to be built at Pembroke. The tenders are to be returned by the first week in August. These cruisers are to be practically of the same type as the Duke of Edinburgh laid down at Pembroke, and to be engined by Messrs. Hawthorn, Leslie & Co., Newcastle-on-Tyne, and as the Black Prince, being built and engined by the Thames Ironworks. These ships are of the central battery type, with most of the quick-firing guns within the citadel and separated by armored bulkheads or traverses, while the forward and aft guns are in separate gun towers. This enables six 9.2-inch guns to be mounted, one at each corner of the citadel, with separate bow and stern chasing guns of the same calibre. In addition there are to be ten 6-inch quick-firers and 28 small guns. The Duke of Edinburgh class of ship has a length of 480 feet, a beam of 73 feet 6 inches, and at 27 feet draught the displacement will be 13,550 tons. A speed of 22.33 knots is to be reached when the engines are developing 23,500 horsepower.—*United Service Gazette.*

The first-class armored cruiser Donegal, the latest production of the Fairfield Shipbuilding and Engineering Company, Limited, for the British Admiralty, returned to Fairfield Dock on Tuesday, the 14th Sept. having completed the trials stipulated in the contract. The following is a statement of the results: One-fifth power, 4674 indicated horsepower, 88.8 revolutions, 14.75 knots speed; three-fourths power, 16,333 indicated horsepower, 136.4 revolutions, 22.30 knots speed; full power, 22,154 indicated horsepower, 146.8 revolutions, 23.737 knots speed.

Several of the smaller armored cruisers have made their trials, but not with altogether satisfactory results. The Euryalus and the Essex have returned to the yards for further alterations. On the other hand, the Monmouth and the Berwick have accomplished successful runs. The Monmouth completed an interesting series of progressive speed trials to determine the effect of the use of propellers with increased surface and coarser pitch than in the case of the screws tried in preceding vessels of this class. This vessel is supplied with Belleville boilers. At the eight hours full-power run the results were as follows: Vacuum, 26.5 starboard, 26 port; revolutions, 140 starboard, 138 port; I. H. P., 11,049 starboard, 11,140 port, giving a collective H. P. of 22,189; and a speed of 22.8 knots. The coal consumption worked out at 1.97 lb. per I. H. P. per hour. Under more favorable conditions as regards weather it is probable that a higher speed might be attained. Particular interest attached to the relative results obtained with the use of different propellers. Those in the Bedford were of the same diameter, 15 feet 9 inches, but the pitch, which in the Bedford was 19 feet 2 inches, was in the case of the Monmouth increased to 20 feet, and the surface, which in the former ship was 57 square feet, was increased in the latter to 80 square feet. With 16,005 I. H. P. in the Bedford the speed obtained was 22.2 knots, and with 22,457 I. H. P. the speed was 22.7 knots; similar horsepowers in the Monmouth gave 21.4 knots and 22.8 knots. The Berwick attained even better results. This vessel is supplied with Niclausse boilers, and for her full power trial the following are the figures. Vacuum, 27 inches; revolutions, 140.4; collective H. P., 22,680; coal consumption per I. H. P., 1.91 lb.; and speed, 23,613 knots. These are the best results yet obtained, and show that with efficient working of boilers and machinery the County class should attain a speed well over 23 knots. The Monmouth was built and engined by the London and Glasgow Shipbuilding Company, and the Berwick was built by Messrs. Beardmore at Govan, the Niclausse boilers being supplied by Messrs. Humphrys, Tenant & Co., Deptford.

A report from Hong-Kong states that the Spartiate made a capital run to that port on her maiden trip. She averaged on the voyage 13 knots, which is her ordinary cruising speed, and expended 2600 tons of coal on the voyage, which gives an average of 2 lbs. per I. H. P. for all purposes. The Amphitrite cruiser, on the same voyage, at an average speed of 13 knots, consumed 3900 tons, while the Blenheim cruiser, fitted with Scotch boilers, used nearly 4000 tons for an average speed of less than 12 knots.—*Page's Magazine.*

The Essex, first-class armored cruiser of the County class, completed her official trials the end of last week at Plymouth with most satisfactory results. The Essex was built at H. M. Dockyard, Pembroke, at which port her machinery, designed and constructed by Messrs. John Brown & Co., Clydebank, was fitted on board. Owing, however, to the lack of docking facilities the ship had to be brought round to Devonport to be drydocked, and thereafter to carry out her official programme of trials. At a mean draft of 24 feet 6 inches the following results were obtained on the three trials respectively: Thirty hours' trial at one-fifth power—steam, 177 lbs.; vacuum, 26 inches; revolutions, 81.7; I. H. P., 4658; and mean speed, 13.84 knots. Thirty hours' trial at four-fifths power—steam, 250 lbs.; vacuum, 27.2 inches; revolutions, 121.2; I. H. P., 16,132; and mean speed, 19.28 knots. Eight hours' full power trial—steam, 275 lbs.; vacuum, 26.5 inches; revolutions, 140.7; I. H. P., 22,219; and mean speed, 22.8 knots. The Essex proceeded out on her circle and anchor trials, and will return to Pembroke to complete for sea.—*United Service Gazette.*

Some five or six weeks back it was announced from a private source that the new "scouts" were to be built by the four firms now engaged in

the construction of similar vessels; but only now has an official communique been sent to the press by the Admiralty. The firms are the Fairfield Company, who are building now the Forward; Vickers' Sons, and Maxim, Limited, who have the Sentinel in hand; Sir W. G. Armstrong, Whitworth and Co., Limited, who have the Adventure on the stocks at Elswick; and Messrs. Laird Bros., who got the original contract for the Pathfinder. As was mentioned at the time, the new vessels will be duplicates of those in hand. They vary from the 2900 tons displacement and 17,000 I. H. P. of the Sentinel to the 2545 tons and 16,000 I. H. P. of the Fairfield boat. In each case the builders guarantee 25 knots speed with 150 tons of coal in the bunkers. The armament in each case is to be the same—ten 12-pounder quick-firers. It may also be added now that it is the intention to order the new torpedo boat destroyers from firms who are now completing the 25½-knot destroyers ordered a year ago, as soon as they pass one of their vessels successfully through trials. Prices for the new work will be arranged on the old basis, not necessarily at the same scale of wages, etc., the price of the four or five firms interested being sufficient competition.—*United Service Gazette.*

NEW TORPEDO BOATS FOR THE BRITISH NAVY.—Messrs. John I. Thornycroft & Co., Limited, of Chiswick, have just completed the five first-class torpedo-boats Nos. 109 to 113, recently ordered of them by the British Admiralty. These boats are 166 feet long by 17¼ feet beam, and so are slightly larger than the four similar boats built by the company two years ago, being 6 feet longer and 3 inches wider in the beam. The armament consists, as usual in this class of boat, of three deck torpedo-tubes (two forward on the broadside and one aft) and three 3-pounder guns similarly disposed. The propelling machinery consists of one set of Thornycroft inclined four-cylinder triple-expansion condensing engines driving a single screw, and steam is supplied from two Thornycroft-Schulz water-tube boilers of the most modern type. The working pressure is 220 pounds per square inch, and the specified horsepower 2900. These vessels are the first to be tried under the new Admiralty regulations for trials of torpedo boats and torpedo boat destroyers. These regulations are interesting as showing how very searchingly the Admiralty test such vessels before acceptance from the contractors. There are three specified full-speed trials, as indicated in the following table:

Nature of Trial.	Preliminary.	Coal Consumption.	Full Speed.
Duration	Two hours	Four hours	Four hours
Minimum mean speed on measured mile	Contract speed, less ½ knot	Contract speed, less ½ knot	Contract speed, less ½ knot
Minimum mean speed on straight	Contract speed, less ½ knot	Contract speed, less ½ knot	Contract speed.

On each of these trials six runs are made on the measured mile to ascertain the revolutions per knot at the specified speed, and on this basis the speed during the rest of the trial is calculated. If the mean of the six runs is less than the minimum indicated above, the trial has to be abandoned. The specified load is carried on the first two trials, but on the third it is modified, 1 ton (or in destroyers 4 tons) being added or subtracted for every one-tenth of a pound that the coal consumption per indicated horsepower is greater or less than 2.5 pounds. On no trial is the maximum indicated horsepower to exceed that specified by more than 5 per cent. On these vessels the specified load was 42 tons—*i. e.*, more than on the 30-knot destroyers of nearly thrice their displacement—and the speed 25 knots. The results obtained by these boats were very satisfactory, as will be seen from the subjoined table.

In addition to the above, trials of 12 hours' duration were carried out on boats Nos. 111, 112 and 113 at 10, 12 and 8.5 knots respectively, to ascertain the most economical speed. A speed of 12 knots gave the

Results of Trials of Torpedo-Boats Nos. 109 to 113.

Boat.		Preliminary.		Coal Consumption.		Full Speed.	
		Six Runs.	One Hour.	Six Runs.	Three Hours.	Six Runs.	Three Hours
109	Speed.....	24.333	24.950	25.196	25.213	25.143	25.290
	Revs.....	375.8	385.0	389.8	390.0	390.4	392.5
	I.H.-P.	2692	....	2911	2740	2823	2904
110	Speed.....	24.833	24.741	25.679	25.120	25.111	25.333
	Revs.....	379.3	377.9	393.2	384.6	386.2	389.6
	I.H.-P.	2880	....	3120	2889	2949	3069
111	Speed.....	25.392	25.361	25.168	25.321	24.991	25.436
	Revs..... ...	385.9	384.5	384.7	387.0	383.8	390.8
	I.H.-P.	2681	2698	3024	3004	2809	2922
112	Speed.....	25.024	24.939	25.146	25.280	24.851	25.311
	Revs...	389.6	388.2	390.8	392.9	384.5	392.0
	I.H.-P.	....	....	2892	2988	2968	3033
113	Speed.....	25.065	25.163	25.117	24.763 *	25.153	25.122
	Revs.....	385.9	387.3	388.1	382.4	392.7	388.9
	I.H.-P.	2836	2726	2952	2801	2950	2917

* Owing to an oil-pipe becoming displaced on one of the fan engines, it was stopped part of the time.

greatest radius of action, giving 52.36 knots per ton of coal, or a radius of 2200 knots. At 15 knots, the knots per ton were 30.64, and the radius of action 1280 knots, but the coal per indicated horsepower was only 1.387 pounds per hour—a rather remarkable result. The radius of action at full speed is about 300 knots. The above-mentioned trials are, of course, in addition to steaming trials, stopping and starting trials, gun trials, circle trials, trials of auxiliary engines, and minute inspection when the machinery is opened out after trial. The trials have been carried out during the winter and spring, which have been exceptionally stormy, and thus many of them took place in boisterous weather. The vessels proved themselves very good sea boats, and showed that full speed could be maintained in rough weather, and they are remarkably free from vibration. To obtain fifteen successful full-speed trials, one or two had to be abandoned from various causes, but on most occasions the machinery gave the greatest satisfaction in every way.—*Engineering.*

A general signal was made to the Mediterranean Fleet at Gibraltar on July 31 announcing that the Spartiate had beaten the record for first-class cruisers coaling from the Mole, having taken on board 1100 tons in 5½ hours, an average of 200 tons per hour. The Spartiate's name has been placed on the record board.—*United Service Gazette.*

The Arrogant, during her refit in Devonport Dockyard, is to have all her 4.7-inch guns replaced by 6-inch guns.

The New Royal Naval College.—The opening of the new Royal Naval College at Osborne, by the King, inaugurates the scheme of naval training by which executive, engineer and royal marine officers will all receive the same groundwork for their future careers. It is now anticipated that all will be ready for the reception of the cadets by September 15, the delay in completion having been due to the constant rain of both June and July, which upset all calculation, and despite all the efforts on the part of the Office of Works, most energetically seconded by the naval stores branch at Portsmouth Dockyard, made it impossible to push the

operations sufficiently forward for anything in the nature of a formal ceremony by the King.

The Admiralty have displayed an energy and a promptness in connection with the organization and construction of this college which is highly commendable. Evidently very little time has been allowed for "red tape" formalities, as in less than twelve months a well-equipped scholastic institution has been completely built and furnished and the staff appointed. It was on the occasion of his coronation that the King announced his intention of presenting Osborne House and estate to the nation. With the exception of Queen Victoria's apartments, the house is being converted into a convalescent home for officers of the navy and army, but that is altogether independent of the Royal Naval College, which has been specially built by the Admiralty, the area placed at their disposal measuring about 60 acres, which is virtually a fine park, timbered with old trees. The foundations of the college are of the most solid character, consisting of concrete 16 inches thick. The whole enclosed ground was dug out and filled to a depth of 2 feet with sifted gravel, on the top of which was laid 6 inches of concrete, and on this again the patent flooring was set so that there will be no danger of dampness. Deep in trenches lined with concrete the most perfect sanitary arrangements have been carried out. The site of each of the buildings having been prepared in this way, the superstructure was taken in hand. This consists of a wood skeleton, which was sent down from London ready for use. Each beam of wood had its position plainly marked on it, so that the workmen had merely to bolt or nail the frames together. The shell having been completed, the walls were filled in with a new non-flammable material called Uralite, and sheets of this material were afterwards affixed all over the inside and outside of the buildings, so that the woodwork was completely buried and placed out of danger of fire or damage by weather. Fortunately, this material takes paint well, and, as the design of the buildings is most attractive, there is no doubt that the college will be as pleasant to the eye as it will be durable, besides being absolutely fireproof.

One feature of future naval training is beginning when the boys are young. Like their predecessors in the sea service in the early years of last century, these young officers will begin their training early. They will be only 12 or 13 years of age, and the college has been planned specially with an eye to the needs of boys of such comparatively tender years. The work which has been carried out at Osborne for the reception of these young cadets includes the construction of the following buildings, practically all of one story:

Gymnasium, 63 feet by 40 feet.

Recreation room, 102 feet by 40 feet.

Water-tower, with capacity of 7000 gallons.

Three bungalows for cadets' dormitories, baths, etc., 170 feet by 23¼ feet each, with a height from floor to ceiling of 25 feet.

Officers' quarters, including mess room and cabins, forming a "T" shaped building.

Men's quarters for the staff of marines and band in three blocks (72 feet by 25 feet each).

Class rooms for the cadets' studies.

In addition the stables and coach houses are being remodeled to afford a mess room for 360 cadets, additional studies, and quarters for the teaching staff.

The mess room will measure 100 feet by 31 feet, and there will be ten class rooms, the largest 50 feet by 30 feet. The stables and coach houses which have been so converted were originally constructed around a quadrangle. This has been retained, and there is now around the quadrangle a veranda, which, on wet days, will protect the students when passing from one class room to another, or to the mess room. The latter

is a splendid hall, which, when it is furnished and its walls are decorated with the historical paintings and prints which those interested in the navy will doubtless present for the purpose, will be well worthy of the institution.

Each block of buildings will be designated by the name of a famous admiral, as has been done at Greenwich and will be done at Dartmouth. The great dining hall will bear the name of our greatest British commander, the illustrious Nelson.

Just alongside the stable, and connected by a short covered way, is a new building 170 feet long. This will contain the gymnasium, and the recreation room. In addition to the larger apartments, this building will contain more class rooms and rooms in which there will be lavatories and lockers for the boys. Practically all the houses are only one story high, but associated with the general design and connected with the gymnasium is the high water-tower, and near this is a smaller block of buildings containing the latrines, etc. The college will be supplied with water for all purposes and with electricity for lighting by the local authorities.

Next are the three bungalows, which are to form the cadets' dormitories. Each bungalow will house 30 boys, as well as an officer, who will have a cabin to himself. The beds, 15 a side, range down each side of the bungalow, with a gangway in the middle, while between the beds are washstands, and at the foot of each bed the cadet will have his chest. At the end of each bungalow is a smaller building connected to it and forming the bath room for the boys; it includes a plunge bath 12 feet by 10 feet, and, underneath, the heating chamber for keeping the building itself and the water for washing at a suitable temperature. The space allowed for each bed is 1008 cubic feet, and there is a 20-foot space between each of the bungalows. These buildings are of adequate height, well lighted and warmed, and, to judge from the drawings, will be picturesque in appearance. They are connected with one another and with the gymnasium by a long covered veranda fronting the road. Only three bungalows have been erected, but others can be easily added.

Two cottages, for they are little more, lying on the right of the entrance to the grounds, are being converted, one into the captain's residence and the other into a dwelling for the warrant officers attached to the establishment.

The officers' quarters form another set of bungalows, but the civilian instructors are to find accommodation in the town. A building outside the grounds has been acquired for conversion into a hospital. There is to be a bathing place in Osborne Bay, where a house and pier are to be erected. In summer time the Racer will be moored close by to take the cadets for a cruise. She has been permanently attached to the college, and moorings have already been laid down for her. In addition a large number of sailing cutters and pulling boats have been provided for use either on the river or in Osborne Bay.

Some little distance up the river Medina are two fields, of about sixteen acres, having a frontage to the river of something like 1000 feet. These fields, forming part of the Osborne estate, are exactly opposite Shamblers Copse on the west side of the Medina. They have a gradual slope down to the water, and are well above the town, so that from this point upwards there is a clear reach for the use of the cadets in their pulling boats. A small point of land jutting out into the stream is being converted into a pier, and alongside it a slip has been made, on which the steamboats and other craft attached to the establishment can be hauled up. The land contiguous to this pier has been levelled for the erection of a machine shop, 108 feet long by 50 feet broad, where the cadets are to be made practically acquainted with the handling of tools and the working of machinery. The building is on the saw-tooth principle in six bays of 18 feet each, with north lights in the roof. This is the most approved

fashion of building for the purpose at the present time, and the plan allows of unlimited extension to the north. The workshops will contain the necessary lathes, carpenters' benches, and other apparatus for giving a general engineering education. Between this, the principal building, and the water there are to be cadets' dressing rooms and offices for the staff, while to the south are the power house and the laboratory. In the power house there are a small brass foundry and a smith's forge. The shop machinery will be driven by two lines of shafting, each worked by a separate electro-motor, the power being supplied by a De Laval turbo-generator of 30 kilowatts and a smaller dynamo driven by an ordinary engine. Steam will be furnished by two marine boilers. The installation appears to have been in every way completely thought out and to be well fitted for its purpose.

The steamboats attached to the college, three in number, will be stationed here. One, a specially designed 60-foot launch, intended mainly for instructional work, was built by Messrs. J. S. White & Co., at Cowes. The whole of her machinery space is to be enclosed in a large glazed cabin extending nearly the whole length of the boat, and intended to serve as a lecture room. Here the cadets will be taught to take to pieces and put together again engines which have broken down or need repair, and will be shown similar practical illustrations of marine engineering. Special safety arrangements have been devised, so that although the demonstrations are to be most complete, no danger can come to the youthful students. The other boats are intended, one for passage work to Portsmouth and back, and the third, a service 30-foot cutter, to afford the boys experience such as they will get in the navy. The buildings at this part of the establishment will be heated by steam, and electricity will be used for lighting, driving and hauling up the boats, etc. From the day when the boys enter they will be in a naval atmosphere, within sight of the most famous anchorage in the world, and under naval discipline, as interpreted by Captain Rosslyn E. Wemyss, R. N., M. V. O., who has been appointed governor, while Professor Ewing has been appointed director of studies.—*United Service Gazette.*

An order has been issued by the Admiralty at the naval ports giving particulars of the new short service system for manning the royal navy. At present not more than 1000 seamen and stokers are to be entered for, as it is termed, "non-continuous service." They are to join the general depots at Portsmouth, Devonport and Chatham, and after undergoing a course of training will be passed into the navy for five years, and complete the remainder of the twelve years in the royal fleet reserve. Men who can pass the naval examination for able seamen will be entered in that rating, and those who have had no previous experience will be allowed to join as ordinary seamen until they qualify for the higher rating. They will receive the following rates of pay, in addition to provisions: Ordinary seamen, 1s. 1d. per day; able seamen, 1s. 4d.; and leading seamen, 1s. 6d. per day. After completing twelve years, five in the navy and seven in the royal fleet reserve, they may re-enroll in the reserve for successive periods of five years until the age of fifty-five years is reached, when they will receive a pension of £12 per annum. While borne in the reserve they will receive a retainer of 6d. per day. They will be subject to call in the case of emergency, but are not available for fleet manœuvres. The men entered as non-continuous stokers will receive the following rates of pay: Stokers (second class), 1s. 5d. per day, and on advancement to stoker, 1s. 9d. per day. The same regulations as regards service and pension will apply to them as to the seamen, and the clothing gratuity of £10 will also be paid them on entry.—*United Service Gazette.*

THE NAVIGATING BRANCH.—The recent Admiralty circular will be regarded as a further proof, if any were needed, of the determination of

Lord Selborne's board to weld the officers of the fleet into "one harmonious whole." Twenty-five years ago the process of abolishing the separate line of navigating officers was begun, and executive officers were offered certain inducements to specialize as navigators and pilots, just as others had been specializing as gunnery and torpedo lieutenants. So far as it has gone the experiment has been very successful, and the new navigators have proved as skillful and competent as the old "masters" now fast disappearing from the active list. In one important respect, however, the original design of the Admiralty has not been fulfilled. The executive navigators or lieutenants (N) have been unduly withdrawn from the general work of the executive branch, thus tending to defeat the object for which the change was made. In effect the new navigators have specialized more than was intended, and this is now to be remedied. A few, it is true, have reached the captain's list, and many more have become commanders, yet, for various reasons, the navigators have not been fully merged into the higher ranks of the fighting line. The *Times* attributes this to two causes: The tendency of officers to enter the (N) line for the sake of the extra pay, and to the survival of a certain caste prejudice against this valuable branch. The executive navigators contend, rightly or wrongly, that the Admiralty have, in a measure, broken faith with them. The line, they say, has not proved so secure a stepping-stone to promotion as they were led to expect. In any case, this is now to be remedied, and young officers may specialize as navigators without apprehension for their future prospects.

A feature of the scheme is the establishment of a navigation school ship, through which all aspirants who wish to specialize in this direction will be passed, whilst lieutenants (N) will return to re-qualify from time to time. A distinction will still be made between junior navigators and those who are qualified to pilot a first-class ship. After three years' service as navigator, every such specialist will be required to study for a month in the navigation school and then present himself for the final test in pilotage. But during his service in sea-going ships the lieutenant (N) will undertake his full share in the ordinary duties of his cloth. When borne in the reserves he will go through courses of instruction in gunnery and torpedo work. Thus the officers (N) will be eligible to succeed to the position of first lieutenant if a vacancy occurs during a commission. But it is expressly stated that "in ships where no commander is borne, the navigating lieutenant will not be appointed for first lieutenant's duties." The circular also provides that when a commander is borne for navigating duties he will not be the executive officer. In a measure these exceptions appear to be in contradiction to the aim of the circular.

As regards the selection of navigators, it is provided that midshipmen shall work under the navigating officer, and that the most efficient in the work be recommended to the Admiralty. Sub-lieutenants who obtain first-class marks in the pilotage examination (in passing for lieutenant) will be selected for further training in preference to others whose specialty lies in another direction. No officer will be appointed as the responsible navigator of any ship until he has undergone a course in the navigation school. This course will extend over ninety working days. Then will follow a period of probation in a battleship, under the eye of the navigating officer, upon whose report ultimate selection will largely depend. With these safeguards in force there is reason to anticipate that the standard of pilotage throughout the navy will be raised, notwithstanding that the new specialists will be required to keep in closer touch with the general working of the service. As the *Times* observes, the broad principle underlying this change is wholly admirable, since the plan is clearly designed to equalize the position of the several specialists in accord with the spirit of the Admiralty training scheme. It may be found undesirable in the future to appoint officers of the rank of commander to navigate battle-

ships and large cruisers, but this is a matter that can easily be modified, if necessary. On the same principle it should be possible for a first lieutenant serving directly under a captain to pilot the ship, with some little help from his juniors. Lieutenants (N) have already fulfilled both functions in a good many cases—*Army and Navy Gazette.*

On Monday last sail drill, that has been a feature of the training ship St. Vincent, was given up. At last it has occurred to the authorities that our battleships are really never likely to sail into action, and, inspired by this great discovery, the sails have gone. In quite dramatic fashion, after a drill with them on Monday, the sails were hauled down off the yards which are now left bare—possibly with a view of putting temptation out of reach.—*Engineer.*

ITALY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Roma	12,625	Gov't Yard, Spezia.	Launched Sept. 20, 1903.
Napoli	12,625	Gov't Yard, Castellamare.	Building.
I	12,625	Gov't Yard, Venice.	Projected.
Vittorio Emanuele	12,625	Gov't Yard, Spezia.	Not yet launched.
Regina Elena	12,625	Gov't Yard, Castellamare.	Not yet launched.
Benedetto Brin	13,526	Gov't Yard, Castellamare.	Launched Nov. 7, 1901.
Regina Margherita	13,526	Gov't Yard, Spezia.	Under trial.
Armored Cruiser.			
Francesco Ferruccio	7,460	Gov't Yard, Venice.	Launched April 30, 1902.
Torpedo Cruiser.			
Costii	1,313	Gov't Yard, Castellamare.	Under trial.

JAPAN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
1, 2, 3	15,000	.....	To be built 1904–1909.
Armored Cruisers.			
1, 2, 3	9,900	.....	" " "
Protected Cruisers.			
3, 4	5,000	.....	" " "
Nitaka	3,470	Yokosuka.	Launched.
Tsuchina	3,470	Kure.	Building.
Otawa	3,000	Yokosuka.	"

The Japanese battleship Chinyen, which was at gun practice in Ise Bay on May 27, suddenly left off and rapidly returned to Yokosuka. It appears that a shell which was being placed in a 30½ cm. Krupp gun exploded, and six men were severely wounded, six others receiving slighter injuries.—*United Service Gazette.*

RUSSIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
I	16,000	St. Petersburg.	Building. Complete 1905.
I	16,000	.....	Projected.
I	16,000	.....	"
I	16,000	.....	"
I	16,000	.....	"

VESSELS BUILDING.—*Continued.*

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Imperator Alexander III.	13,516	St. Petersburg.	Launched Aug., 1901.
Borodino	13,516	"	Launched Sept., 1901.
Orel	13,516	"	Lchd. July, 1902; compl. 1904.
Kniaz Suvarof	13,516	"	Lchd. Sept., 1902; compl. 1904.
Slava	13,516	"	Lchd. Aug. 30, 1903.
X	12,500	Nicolaiev.	Building.
X	12,500	"	"
Ivan Zlatoust	12,500	Sevastopol.	"
Coast Defense Iron Clad.			
Admiral Boutakof	6,000	St. Petersburg.	Building.
Protected Cruisers.			
Oleg	6,750	St. Petersburg.	Launched Aug. 27, 1903.
Kagul	6,750	Nicolaiev.	Launched June 2, 1903.
Otchakof	6,750	Sevastopol.	Launched Oct., 1902.
Vitiaz	6,750	St. Petersburg.	Building.
X	6,750	"	"
Boyarin	3,200	Copenhagen.	Under trial.
Kalgoula	3,200	Nicolaiev.	Building.
Almaz	3,200	St. Petersburg.	Launched June 2, 1903.
Zemtchug	3,200	"	Launched Aug. 27, 1903.
Izumrud	3,200	"	Building.
7	3,200	Dantzic (Schichau).	"
8	3,200	St. Petersburg.	Projected.

THE ESTIMATES FOR 1903.—The estimates for the present year amount to 104,417,791 roubles (£10,876,853 5s.), showing an increase of 6,338,802 roubles (£660,291 17s.) over last year's. This increase is made up as follows:

	Roubles.	£ s.
For maintenance of fleet and for new ships	4,000,000	= (416,666 13)
Extension works at Vladivostok	1,181,550	(123,078 2)
Extension works at Port Arthur	905,000	(94,270 17)
Miscellaneous expenses	252,252	(26,276 5)
The distribution is as follows:		
1. Maintenance of central and port administrations	2,438,249	(253,984 5)
2. Upkeep of training establishments	1,175,502	(122,448 2)
3. Ordinary construction and guns	40,449,682	(4,213,508 12)
4. Admiralty yards and workshops	5,623,877	(596,238 0)
5. Ships in commission	21,462,717	(2,235,699 19)
6. Surveying and beacons	1,535,015	(159,897 8)
7. Construction and rent of buildings	5,216,372	(543,372 2)
8. Pay and rations of men on shore	11,608,550	(1,209,223 19)
9. Rewards, pensions and allowances	1,492,351	(155,453 5)
10. Medical care and hospitals	1,266,437	(131,920 10)
11. Various items	1,951,353	(203,265 19)
12. The construction of Emperor Alexander III. Harbor	2,349,033	(244,691 0)
13. Expenditure on surveying	54,700	(5,697 18)
14. Extension and improvement of Vladivostok	3,181,559	(331,411 8)
15. Port Arthur	4,105,000	(427,604 0)
16. Erection of a new slip at Galerny Island	407,394	(42,436 18)
Total	104,417,791	(10,876,853 5)

The active list of officers consists of 24 vice-admirals, 35 rear-admirals, 105 captains, 351 commanders, 900 lieutenants, and 775 junior officers, a total of 2190.

The marine artillery corps is in process of disbandment, and the following officers are the only ones now attached to it: 2 lieutenant-colonels, 3 captains, and 1 staff captain.

The navigating officers corps is also being disbanded, and consists now only of 2 colonels, 7 lieutenant-colonels, 16 captains, and 1 staff captain.

The engineers corps consists of 22 inspectors of machinery, 208 chief engineers, 208 engineers, and 200 assistant engineers.

There are 750 naval cadets, who are divided according to yearly terms extending to six, but there are numerous vacancies in the senior terms.

The number of warrant officers, petty officers, and men, is 62,226.

Particulars are now obtainable of the new Russian battleships whose existence the Admiralty refused to credit. They will—as we stated months ago—carry four 12-inch and twelve 8-inch guns. In type they will be enlarged Borodinos, and they will closely resemble those vessels. That is to say, the secondary guns will be in pairs in turrets—two pairs at the base of each mast, and the third pair of turrets amidships at a lower level, so that eight guns can be fired axially without the slightest risk of interference. The six new ships will be of 16,000 tons displacement, 430 feet long, 80 feet beam, and 26 feet mean draught. The horsepower will be 18,000, from which a speed of 18 knots is expected. Two of the ships will have Belleville boilers, two Niclausse—the boilers of the other two are not yet decided on.

The new Russian cruisers will be three in number. Their exact size and type is as yet undecided, two alternatives being under consideration. One party desires to see a 10,000-ton vessel—a species of Borodino armed with four 8-inch and twelve 6-inch guns; the other is in favor of reproducing the 8000-ton Bayan, which has been a singularly successful vessel. The advocates of this type desire to see 23-knot cruisers, and insist on speed before power. The Bayan is nominally of 21 knots, but she has several times easily exceeded that contract speed; she has also maintained it without difficulty for some twelve hours on several trials.

The battleship Tsarevitch has been doing a singularly successful series of trials, and the anticipated speed has been greatly exceeded. Designed for 18 knots, she is stated to have done well over 19, and for the present holds the battleship speed record.—*Engineer.*

Arnold-Forster says: The Admiralty have not received official particulars as to the Russian shipbuilding programme. Such particulars are not published or made public by the Russian Government. It is known, however, that two first-class battleships have now been commenced in the Black Sea, and it is considered probable that two more will be laid down at an early date in the Baltic.

The Russian Admiralty has recently ordered the laying down of two more battleships for the Black Sea fleet, one at Nicolaeff, and the other at the Sevastopol Admiralty Yard. These vessels are to be of 12,000 tons, but further details have not been reported, although it is believed that the engines will be made by private firms. Three new torpedo boat destroyers are also reported to be under consideration, to be built by private firms, and to be of the same type as the Zavietni, which was built at Nicolaeff. The Russian Black Sea fleet now consists of seven battleships, the Potemkin, Tri Sviatetilia Rostislav, Georghi Pobyedonosets, Dvenadsat Apostolov, Sinope, and Tchesma, the Ekaterina being at present laid up for repairs to her machinery.—*Page's Magazine.*

The Russian protected cruiser Almaz was launched at the Baltic yard, St. Petersburg, on June 2, and on the same day the Kagul took the water at Nicolaieff. The Almaz belongs to the smaller class, displacing 3285

tons, with a length of 325 feet, beam 43 feet 6 inches, and draught 17 feet 6 inches. She is to have engines of 17,500 horsepower supplied by sixteen Belleville boilers, intended for a speed of 19 knots. The protection is to be given by a 2.7-inch belt, and the principal guns will have 5-inch protection. There are to be six 4.7-inch, and the armament will also comprise eight 1.8-inch, two 1.4-inch and three machine guns. The ship has a double bottom and 44 water-tight compartments. The Kagul displaces 6250 tons, and is 436 feet long with 64 feet 5 inches beam. In thickness the protection is analogous to that of the Almaz, but the armament consists of twelve 6-inch, twelve 3-inch, and eight 1.8-inch guns. The torpedo transport Volga is progressing at St. Petersburg, and her name plate was put in position when the Almaz was launched.

The new Russian cruiser Kagul, which was launched at Nikolaieff, on the Black Sea, on June 2, was laid down in the Admiralty yard there in August, 1901. The dimensions are: Total length, 439 feet 7½ inches; greatest beam, 54 feet 5½ inches; draught, 20 feet 7½ inches, and displacement, 6675 tons. Two engines, of 19,500 indicated horsepower, are expected to give the Kagul a speed of 23 knots. The armament is carried in two turrets and four armored casemates; it consists of twelve 6-inch guns of 45 calibres, and of twelve 3-inch guns of 50 calibres, with six 46-mm. quick-firing guns, and two submarine torpedo tubes. It is to be remarked that all the material used in the construction of this vessel was supplied by Russian works.—*Engineer.*

SPAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Protected Cruisers.			
Reina Regente.....	5,372	Ferrol.	Building.
Isabel la Catolica.....	3,500	Canaca.	"

THE SPANISH ARMORED CRUISER CARDENAL CISNEROS.—The naval chronologist would be hard put to it to decide whether or no the Cardenal Cisneros is a "new ship." She has just been doing her acceptance trials, and might therefore take rank with the Bayan, a ship of about the same size and which ran her trials about the same time. On the other hand, she was launched in 1897, and designed about 1887-88—which is rather a long time ago. She was then a copy of the British Orlando—a wonderful ship in the eighties, but wonderful now chiefly for museum purposes.

At the time of the war with America the Cisneros was ordered to prepare for sea. The order seems to have been consummated during the present year or so. As peace was made during the requisite preparations, the Spaniards took advantage of the fact to apply the lessons so painfully learned at Santiago with the Cisneros' earlier sisters Vizcaya, Infanta Maria Teresa, and Oquendo, and it is this fact, and not her importance as a warship, that makes the Cisneros of such supreme interest. The victors, both American and Japanese, of recent naval fighting have applied "lessons," but the Japanese did not have very much experience of nasty hits, while the Americans had practically none. On the other hand, those Spaniards who survived the Santiago fight have certainly unique knowledge as to what modern naval warfare is like. And in the Cisneros their experiences have been embodied so far as 7000 tons will allow.

The dimensions, etc., of the Cisneros, are as follows: Displacement, 7000 tons; length between perpendiculars, 348 feet; beam (extreme), 60 feet 3 inches; draught (mean), 25 feet.

As originally designed she carried two 9.4-inch Hontorio guns, one forward, one aft, armor protected; ten 5.5-inch crowded into an unprotected

upper deck battery *à la* Orlando class, and a number of unprotected six-pounders on the main deck amidships under the 5.5-inch.

What belt she was originally designed to carry is not clear, but the belt she now has is 278 feet long by 5½ feet deep. It varies from 12 inches amidships to 6 inches forward and 8 inches aft. It is believed to have been originally intended to be 230 feet long only, by 12 inches to 10 inches thick, and perhaps the 6-inch and 8-inch continuations are recent innovations. But this is uncertain.

There are 8-inch bulkheads terminating the belt—above there is nothing.

In re-designing, two of the 5.5-inch guns were taken away altogether, the other four being put into thin casemates of 2¾-inch chrome steel. This is not much protection; still, it will save any "wiping out" of the battery by a single shell—which is what happened at Santiago. It is doubtless the thickest armor that could have been used, and in these days of capped projectiles 2¾-inch may go as far as 5-inch.

The 6-pounder battery amidships has been abolished altogether, these guns being placed on top of the amidship casemates instead—an infinitely better position so far as survival is concerned.

In the orginal design the big guns had barbettes of 10½-inches with 8-inch hoists and 4-inch shields. The actual barbettes are 8-inch with 4-inch hoists. The thickness of the shields is uncertain, but it is believed to be 8 inches. Instead of a 12-inch conning tower there is an 8-inch one.

Above-water torpedo tubes at bow and stern are retained. Since Santiago both the United States and the British navies have been busy taking away above-water tubes. The Spaniards, who were the people whose tubes came under fire, have retained them, realizing that it is possible to go into action without torpedo tubes loaded.

Another feature is the cut-away bow. It should enable the bow chaser to fire right ahead quite comfortably, and without blowing away pieces of the ship.

The Cisneros is fitted with two sets of horizontal triple-expansion engines, designed by Messrs. Maudslay, and built at Barcelona by a Spanish firm. The boilers are cylindrical. Designed indicated horsepower 10,000 = 18 knots with natural and 15,000 = 20.25 knots with forced draught. As has already been mentioned in *The Engineer*, forced draught was not used on trials, on the grounds that if the ship were pressed then she might not stand pressing so well later on, should war demand it. The coal carried is 750 tons at normal displacement. The maximum stowage is 1200 tons.—*Engineer*.

SWEDEN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Coast Defence Battleships.			
Aran	3,650	Gothenburg.	Under trial.
Wasa	3,650	Malmö.	Launched.
Manligheten	3,650	"	Building.
Tapperheten	3,650	Stockholm.	Launched.
Dristigheten	3,450	Gothenburg.	Under trial.
Armored Cruiser.			
Fylgia	4,000	Stockholm.	Building.

TURKEY.

The Turkish cruiser Abdul Medjidie was launched at the Cramps' shipyard on July 25. She is of 3250 tons displacement and will be armed with two 6-inch, eight 4.7-inch, six 3-pdr. and six 1-pdr. R. F. guns, all protected by shields.

UNITED STATES.

VESSELS BUILDING.

No.	Name.	Speed. Knots.	Where Building.	Degree of Completion. Aug. 1.	Sept. 1.
	Battleships.				
11	Missouri	18	Newport News Co.	96%	97%
12	Ohio	18	Union Iron Works.	80	81
13	Virginia	19	Newport News Co.	40	42
14	Nebraska	19	Moran Bros. Co.	22	25
15	Georgia	19	Bath Iron Works.	33	35
16	New Jersey	19	Fore River S. & E. Co.	41	43
17	Rhode Island	19	Fore River S. & E. Co.	41	44
18	Connecticut	18	Navy Yard, New York.	13	15
19	Louisiana	18	Newport News Co.	19	21
20	Vermont	18	Fore River, S. & E. Co.	0	0
21	Kansas	18	New York S. B. Co.	0	0
22	Minnesota	18	Newport News Co.	0	1
	Armored Cruisers.				
4	Pennsylvania	22	Cramp & Sons.	54	57
5	West Virginia	22	Newport News Co.	55	57
6	California	22	Union Iron Works.	37	39
7	Colorado	22	Cramp & Sons.	58	60
8	Maryland	22	Newport News Co.	54	56
9	South Dakota	22	Union Iron Works.	33	35
10	Tennessee	22	Cramp & Sons.	3	5
11	Washington	22	New York S. B. Co.	2	4
	Protected Cruisers.				
14	Denver	17	Neafie & Levy.	95	97
15	Des Moines	17	Fore River S. & E. Co.	90	92
16	Chattanooga	17	Lewis Nixon.	74	74
17	Galveston.	17	Wm. R. Trigg Co.	67	68
18	Tacoma	17	Union Iron Works.	83	86
19	Cleveland	17	Bath Iron Works.	98	99
20	St. Louis	22	Neafie & Levy.	23	25
21	Milwaukee	22	Union Iron Works.	27	29
22	Charleston	22	Newport News Co.	46	48
	Gunboats.				
17	Dubuque	12	Gas Engine & Power Co.	0	3
18	Paducah	12	Gas Engine & Power Co.	0	3
	Training Ships.				
	Cumberland	Sails	Navy Yard, Boston.	0	0
	Intrepid	Sails	Navy Yard, Mare Island.	0	0
	Boxer	Sails	Navy Yard, Portsmouth, N. H.	1	1
	Torpedo Boats.				
19	Stringham	30	Harlan & Hollingsworth.	95	95
20	Goldsborough	30	Wolff & Zwicker.	99	99
27	Blakely	26	Geo. Lawley & Son.	99	99
29	Nicholson	26	Lewis Nixon.	99	99
30	O'Brien	26	Lewis Nixon.	98	98
34	Tingey	26	Columbian Iron Works.	96	96

The recent award of contracts for the three new 16,000-ton battleships of the Vermont class has given the Vermont to the Fore River Ship & Engine Co., and the preliminary work has been started in the yard at Quincy Point, Boston Harbor. This vessel, officially known as Battleship No. 20, and her two sisters, differ from the members of the same class ordered some months ago only in details, their general dimensions being: Length between perpendiculars, 450 feet; length over all, 456

feet 4 inches; breadth, 76 feet 8 inches; depth, 46 feet; displacement, about 16,000 tons; draft, 24 feet 6 inches.

The Vermont will have two 75-foot military masts of steel, one forward and one aft of the superstructure, and three smoke-stacks. There are four 8-inch gun turrets, one at each corner of the superstructure, besides the two 12-inch turrets, forward and aft on the main deck. The hull will be built of half-inch steel with a double bottom and water-tight bulkheads, and 28 tons of cornpith cellulose in a coffer-dam 7 feet high and 30 inches wide will insure protection against injuries at the waterline.

The defensive armor will consist of a protected deck with inch-and-a-half nickel-steel plates on a flat and 3-inch nickel-steel plates on the slopes, a main belt of 9-inch armor 284 feet long and tapering in width from 9 feet 3 inches amidships to 8 feet forward and aft, being reduced, in three reductions, to a thickness of 4 inches at the ends, and 7-inch thick casemate armor around the 7-inch gun ports. The barbettes of the 12-inch turrets will have front plates 10 inches thick with 7½-inch plates in the rear above the gun deck, and will be 6 inches thick throughout below that, while those of the 8-inch turrets will be 6 inches thick in front and 4 inches thick in the rear. The 12-inch turrets themselves will have 12-inch port plates and 8-inch side and rear, while the 8-inch turrets will have 6½-inch plates around the port and 6-inch on the sides and backs. The conning tower will be of 9-inch steel, and the communication tube of 6-inch steel, and all the 3-inch gun-positions will be protected by 2 inches of nickel steel.

The Vermont's armament will consist of four 12-inch, eight 8-inch, and twelve 7-inch breech-loading rifles in the main battery, and in the secondary battery twenty 3-inch 14-pounder rapid-fire guns of 50-calibre, twelve 3-pounder, six 1-pounder semi-automatic rapid-fire guns, two 3-inch field pieces, two machine guns of 30-calibre, six automatic 30-calibre guns.

The Vermont will have two 4-cylinder triple-expansion engines of 120 revolutions per minute, having 16,500 horsepower, the cylinders being 32½ inches, 53 inches, and two of 61 inches, and the common stock 48 inches. For these there will be 12 water-tube boilers with a heating surface of 46,750 square feet, over a grate surface of 1100 square feet, capable of sustaining a working pressure of 265 pounds. The two main condensers have a condensing surface of 10,375 square feet.

The vessel is required to make a speed of 18 knots an hour.

The new battleship will be furnished with a complete electric equipment for lighting, operating the cranes and pumps and the 22 ammunition hoists, serving the deck-winches, turning the turrets and handling the guns. The generating plant will consist of eight 100-kw., 125-volt machines. A wireless telegraph outfit is included in the specifications.

The contract calls for the completion of the three new vessels of the Vermont class in 42 months. The Vermont herself will cost $4,179,000 for the hull and engines.—*Nautical Gazette.*

ORDNANCE AND GUNNERY.

The following are the quarterly returns of the Gibraltar, the flagship on the Cape Station: 9.2-inch guns, twenty-two rounds fired and eleven hits made; 6-inch guns, ninety-seven rounds fired and forty-eight hits made. The best shots in the ship were J. Seaman and J. Calton. Seaman, first captain, fired seven rounds and had six hits; Calton, second captain, fired six shots and had six hits. Their total with the 6-inch gun was thirteen rounds fired and twelve hits made. The informant states: "This is about the first time this particular gun has not had an accident while prize-firing. The average this year is far better than last. The average is 2½ hits per minute per gun."—*United Service Gazette.*

Mr. Arnold White has published the following details of prize-firing of ships in the Mediterranean Fleet: H. M. S. Bacchante, with the 9-inch guns, 27 rounds were fired, and 13 hits were made. With the 6-inch guns, Mark VII, 117 rounds were fired and 73 hits made. The best shots in the ship were Davis, P. O. 1st class, and McDonald, A. B. Five rounds were fired, and five hits made in one minute with the 6-inch Mark VII gun. This prize-firing took place on June 13 at Bizebrica Bay, Malta, in favorable weather. The above two men were both stationed at the same gun. It was a two-minute run. Both men are qualified captains of guns. They managed to get off five rounds each, making ten rounds in all, with ten hits. H. M. S. Ramillies, Lord Charles Beresford's old flagship in the Mediterranean, has achieved the highest average for 6-inch firing on the station. At the last firing for the 6-inch gun an average of 65.6 was attained, which is very good indeed, considering the age and condition of the guns. The Ramillies' score for the last four years' firing with the 6-inch Mark I is as follows: 1900, 43 per cent; 1901, 56 per cent; 1902, 41 per cent; 1903; 65.6 per cent.

Notable in the annual prize-firing of the cruiser Blenheim, writes a correspondent on the China station, was the firing of the after 9.2 gun, which was fired by leading seaman Gourd. In six minutes he fired seven rounds, thus making a record for guns not fitted with telescopic sights. The crews of the two 6-inch guns also distinguished themselves by firing twelve rounds in two minutes, each gun making eleven hits.

The Charybdis, second-class cruiser, on the North America and West Indies station, made some good practice during the firing off Bermuda, on February 27, the guns used being the 6-inch and 4.7-inch. The general result was as follows: 6-inch gun, rounds fired 16; hits, 11; 4.7-inch gun, rounds fired, 121; hits, 89. The best shot in the ship was second-class petty officer G. Tyrrell, whose record with the 4.7-inch was sixteen rounds and fourteen hits in two minutes. On this ship both the 6-inch and 4.7-inch guns are fitted with the old three-motion breech blocks. The 6-inch guns are mounted forward and aft, which means that the gun crews are much more cramped than when the guns are mounted on the broadside.—*United Service Gazette.*

An abstract of the heavy gun prize-firing for the Channel Fleet for the year 1902, issued by Mr. Arnold White, shows that the Majestic and Magnificent, flagships, are the best shooting ships for the 12- and 6-inch guns. The former made a total of 82 hits out of 172 rounds; and the Magnificent made 79 hits out of 144 rounds. The shooting would certainly have been better, states Mr. Arnold White, but for the fact that the sights as supplied by the Admiralty have recently been found to be defective. Serious defects were discovered on the Majestic when Lord Charles Beresford hoisted his flag, and the sights of the other ships in the Channel Fleet were then found to be wrong. The alteration now going on is provided for at the cost of the private funds of naval officers.

A correspondent of the *Western Morning News*, serving on board the Bulwark on the Mediterranean station, writes: We have just finished our prize-firing, and again come out top of the squadron. Four 12-inch guns, 30 rounds, 15 hits; twelve 6-inch guns, 176 rounds, 98 hits. With the 12-inch guns the rate of loading was 1.25 per minute and of hitting .62 per minute. In 1901 the average rate for the whole fleet with these guns was .97 and .33. With the 6-inch guns our rate of loading was 7.3 and rate of hitting 4.1. Fleet average, 4.17 and 1.81. The 1902 return is not yet published. It is rumored that it is delayed until the Parliamentary session is over, to prevent any questions being asked on it. The sight question is a very serious one; most ships here have altered them. The Ocean astonished the world with 156 rounds. We have done 176!

It is officially announced that under the new arrangements for the

organization of coastguard duties on shore it has been decided to subdivide the coast line of the United Kingdom into districts on the following principle: England.—1. Eastern District: St. Abb's Head to Dover.—*United Service Gazette.*

The experiment of firing a real shell at one of the Suffren's turrets took place on Tuesday at Brest. The Masséna fired three shots as aiming shots, and then a fourth shot was fired at the turret. The shell rebounded and burst into fragments about a hundred yards from the vessel. All that the watchers on shore could see, however, was a large black blotch spread over the centre of the turret. The actual damage done will not be revealed, every precaution being taken to keep the matter secret. Later a second shell was fired at the turret. Some of the splinters of the shell rebounded over 600 yards, falling near a tug moored some distance behind the Masséna. The flag of the Minister of Marine was hoisted on the Masséna, and many distinguished French naval officers accompanied him.—*Army and Navy Gazette.*

The experiments on the turret of the French battleship Suffren, to which a reference is made in another column, have a curious resemblance to some absolutely similar trials which were carried out in this country as far back as 1872. In July of that year two shots were fired at the 14-inch turret of the Glatton from the 25-ton gun of the Hotspur. The second shot struck the turret at the junction of two plates, and lifted the upper one, penetrating the teak backing, and the inner skin burst open. The striking force was estimated at 6100 foot-tons. What completes the analogy, however, is the fact that in the turret were three animals, not one of which was injured in the slightest, while after the experiments the turret was revolved and the guns fired without any difficulty, this proving that there was comparatively little damage done by one shot striking. On the other hand, in the Suffren experiments shell was used in place of shot, and it may have been the intention of the French Ministry of Marine to find out if the shell would penetrate the armor plating and explode *inside* the turret, a situation which many writers of articles and stories on naval war of the future have deemed likely, and have depicted with a wealth of coloring. That the shell did not do so, however, is evident from the fact that it was shattered and that pieces fell all around, doing some damage to the deck but without injuring any one.—*Army and Navy Gazette.*

The remarkable results achieved in the series of trials of the new 7.5-inch Vickers naval gun conducted by the Chilian Naval Commission preparatory to the fitting of the guns on board the battleship Libertad, being completed at Barrow-in-Furness, once more prove the advantage of nitro-cellulose as a propellant for the modern wire-wound gun. The Chilians, like most of the European and American powers, adopt this compound, and the 7.5-inch weapon tried last week developed the exceptionally high velocity of 3003 feet per second with a pressure of 18½ tons to the square inch. The British "Service" weapon of this calibre using cordite is in official records given a velocity of only 2600 feet per second. The effect on energy is most marked. The guns for the Chilian ship developed a muzzle energy of 12,570 foot-tons, as compared with 9340 foot-tons in the case of the "Service" weapons. The effect against modern armor is in direct proportion. At a range of 2000 yards the Chilian gun, using capped shot, would perforate armor of the most modern type 7 inches to 8 inches thick, and at fully three miles range 5-inch to 6-inch armor.—*United Service Gazette.*

In reply to a question by Mr. Harmsworth about the gun sights of the Majestic, Mr. Arnold Forster has admitted that modifications in the

system of turret sighting as originally fixed to the ships of the Majestic type are desirable, and improved sights are to be issued almost immediately. In this connection it may be mentioned that it is quite two years ago since attention was first called to the defective sights of a number of our ships. It was stated in a contemporary last week that at the trials of the Donegal the target which had been supplied by order of Sir Edward Seymour was not used, and the question was asked why the admiral's programme was not carried out. We believe the facts are that the sighting appliances were such that no aimed shots could be fired, and as the sights are a part of the mounting it was useless to proceed with the trials. It is currently reported that the same difficulty exists in all the ships of the class to which the Donegal belongs. If this is the case it is not surprising that the captain of the Excellent refused to carry out the programme.—*United Service Gazette.*

The Belleisle, hulk, which has been submitted to a series of experiments without being sunk by gun attack, was on Friday last week attacked by a torpedo in Portsmouth Harbor and heeled over and sank in twenty minutes. A compartment was built outside the port bow below the water line and this compartment was filled with corn-pith cellulose. At the time of the experiment there were 10 feet of water under the keel of the ship. Early on the Friday morning divers were sent down to lash a Whitehead torpedo under the compartment, and the torpedo was fired from the Vernon by means of an electric circuit. No sooner was the torpedo exploded than—as seen from a distance of less than a mile—a spray that rose to an approximate height of 40 feet was sent into the air and the ship immediately gave a heavy list to port. As a matter of fact, however, the force of the explosion had not only smashed the special compartment, but had blown the whole of the cellulose into the air, and, simultaneously, the concussion had so violently torn open the side of the ship that the water rushed in with considerable force. It had been determined in the event of the cellulose effectually plugging the breach to take the ship back to the dockyard for inspection, but so rapidly was the heeling over that three tugs were employed in pushing the Belleisle towards the shore, where she sank in 20 feet of water on the Porchester mud in Bomb Ketch lake. As the damaged side of the vessel lies on the mud it will be impossible to discover the extent of the rent in her hull until she is raised, and as she is practically beached some weeks may elapse before she returns to the dockyard. The rapidity with which the Belleisle sank is, however, conclusive evidence of the destructive power of the torpedo, while the instantaneous discharge of the cellulose into the air disproves the theory as to its plugging capacity. —*United Service Gazette.*

Heavy Guns in the Field in South Africa (Extract from a paper by Lieutenant-Colonel Inglefield in the Royal Artillery Institution).—Some particulars with regard to ammunition are worth noting.

The shell used with 4.7-inch guns were lyddite and shrapnel. It would be a great advantage if these two projectiles could be made of the same length and of the same weight. The shrapnel, filled and fused, weighs 45 pounds, and the lyddite, also filled and fused, 46 pounds 9 ounces. The latter, too, is considerably longer than the former. As a result the lyddite is more affected in flight by a cross wind, also the difference of over 1½ pounds in weight causes the two shell to range differently, so that, having found the range with one, it is impossible to turn to the other without ranging again from the beginning. This manifestly is a serious drawback.

A word now as to the relative merits of lyddite and shrapnel for work in the field.

Lyddite, except for one solitary trial at Omdurman, where it was employed chiefly against buildings, had never been used in war before this

campaign. I think I am right in saying that great things were expected of it. What the actual effect in South Africa was (so far as I had occasion to observe) will, it seems to me, be best explained, if I record the results of observations made on various occasions.

At Boshfontein, some 50 miles west of Pretoria, on the 10th November, 1900, a 4.7-inch gun came into action (range 3000 yards) against a low range of rocky kopjes held in force by the enemy. Only lyddite shell were used, the shooting was good, but the effect from what was afterwards ascertained, was practically nil. The only shell that appeared to do any damage was one that fell short, and landed in a building which had a thatched roof. It completely wrecked the place and set it on fire. I visited it afterwards. It was hard to believe that one shell could cause so much damage. Again at Nooitgedacht (13th December, 1900) a building was fired by a lyddite shell in the same way, and apparently with equally disastrous results. Thus lyddite against buildings appears to be very effective.

I used it also against the enemy's artillery at Hekpoort on the 6th of September, 1900, when a shell fell close to a Boer gun. It seemed to fall on the very spot whence the fire came, yet the enemy were able to withdraw this gun under cover, and eventually get away. Subsequently it was ascertained that only one of the detachment had been wounded and only slight damage done to the carriage.

Again, on the 23rd November, 1900, at Sterkfontein, another of the enemy's guns (it was one of our 12-pounder R. H. A. guns captured some time before by Delarey) was damaged by a 4.7-inch lyddite shell, a mule and a man of the detachment being wounded, but the damage was so slight that again the gun was got away. In this case several lyddite shell appeared to fall so close to the gun that it was astonishing that it could remain in action. An officer who subsequently found himself on the spot where the gun had been, told me the ground all around was so plastered with bits of shell and debris of rock, etc., that it was a marvel to him that the whole of the *personnel* had not been wiped out and the gun captured.

I have already, in speaking of the telescopic sight, quoted another instance of accurate shooting with lyddite, where two shells falling within 10 or 15 yards of a gun produced no effect beyond causing the gun to retire. These cases came under my personal observation, there are probably many others, where the results have been equally unsatisfactory, for I know that as a rule battery commanders were disappointed with the results obtained from lyddite shell.

It would seem, therefore, that a lyddite shell, to be really effective, must either directly hit its objective, or go exceedingly close to it, and the reason for this would appear to be, that although the explosion, or more properly speaking, the detonation of a lyddite shell is tremendous, leading one to anticipate the most disastrous results, yet the effect in reality is exceedingly local. This is borne out by the examination of various places where lyddite shell had fallen, both on rocky and on soft ground.

I was able on one occasion to find the crater made by a shell I had fired on to a very stony kopje. The ground was so hard that the shell had not penetrated more than a couple of feet, in fact barely as much, yet out of that crater I unearthed 17 pieces of the shell, which, together with a portion found lying close to, constituted pretty nearly the whole of the shell. The force of the explosion had driven a large stone weighing some 170 pounds—and which had rested on the edge of the crater—about 15 feet away, but beyond this, the energy of the shell had expended itself entirely in the crater.

I have here another 4.7-inch lyddite shell fired against the rocky kopjes of the Boshfontein position (10th November, 1900). From the gash near its base it will be seen that it struck rock, yet it did not break up. Here again we have a useless shell. In this case the metal appears to

have been so tough that the shell was unable to break up as it should have done.

On soft ground, such as the veldt, a lyddite shell makes a big hole, but so far as I could ascertain, most of the pieces remain in the crater. As a rule, I was only able to discover outside, one or two fragments near the crater, and there were always some inside. So disappointed was I with the results obtained with lyddite shell, that I would have liked to try the effect of using a time fuse, and bursting the shell a few feet above plane, but the experiment was deemed too risky to attempt with the time fuses used for shrapnel. I see now that the Germans have tried this with shell having thick walls, and filled with high explosive, but from what Captain Kenyon—who alludes to this in the

LYDDITE SHELL FIRED FROM 4·7 INCH Q. F. GUN.

R. A. I. "Proceedings" of September last, says—it would seem that they have not found this very satisfactory.

The "time" fuses issued for shrapnel, I may here mention, were not good. The "T. and P. Middle" did not burn long enough, and the "Blue-nose" fuse burnt irregularly. Maybe the latter was not intended for such a high velocity gun. Frequent trials, when two fuses were set exactly the same, proved how unreliable these fuses were.

Lyddite having proved disappointing, permission was obtained to carry a larger proportion of shrapnel. Instead of only 25 per cent, 50 per cent were sanctioned, and shrapnel shell were now used whenever the range was not beyond the capabilities of the fuse.

A good instance of the value of shrapnel fire was afforded in General Clement's attack on Delarey in the Hekpoort Valley, on the 19th December, 1900, when two shrapnel from a 4.7-inch gun, at a range of 5000 yards,

effectively silenced two Boer guns. It was subsequently ascertained that these two shell did considerable damage.

Lt.-Colonel F. A. Curteis, who commanded a battery of 5-inch guns in Natal and in the Transvaal, tells me that he is very much in favor of shrapnel which he considers against troops in the open, or entrenched, as in every way far more deadly than lyddite. Also Capt. D. F. Nicholl, in a lecture he gave at Malta, speaks very highly of the effect of shrapnel fire from 4.7-inch guns at Friederichstadt, where the enemy on the open veldt gave him an excellent target. He says:

"For any one who has not seen it, it is difficult to imagine the effect of such shell in the open country," and he gives the area of ground effectively covered by the bullets at 5000 yards' range, at about 120 yards in depth by 40 in breadth.

The experience I had bears out what he says except that I would put the breadth covered at nearer 70 or 80 yards than 40 yards, the depth too may be greater than 120 yards, but any estimate of that from the gun end of the trajectory must of course to a very great extent be guess-work. This difference in my estimate from his may arise from the fact that my shell may have been burst higher in the air, though I gather that his were not burst low down. It was due to the faulty action of the "blue nose" fuse that the shrapnel which proved so effective in the Hekpoort Valley were burst as high up as they were, but the effectiveness of these shell opened my eyes to the possibility of obtaining excellent results by bursting high velocity shrapnel, containing heavy bullets, far higher in the air than is generally thought advisable.

Now that the conditions of modern fighting have brought about such a great extension on the part of all troops, it has seemed to me one of the weak points of the shrapnel fire from our field guns that the spread of the bullets is not greater. Field guns cannot increase this spread by shortening the fuse, because the velocity of the shell, when opened, is not sufficient to render the small bullets (35 to the pound) effective when released high up, except perhaps at quite short ranges. This the Boers proved to us conclusively on more than one occasion, when their shrapnel bullets fired from field guns of ours that they had taken fell harmlessly among us. But a powerful shell such as a 4.7-inch shrapnel which travels at a far greater speed, and contains over 200 bullets (14 to the pound) is not subject to any such limitations. It will cover quite a large area at very long ranges, and retain its effectiveness. Moreover, by bursting the shell high, it will better search out the enemy behind entrenchments, and by thus keeping his riflemen down under cover, lessen the fire of the defense, and facilitate the advance of the attacking infantry over that now—more than ever—dangerous zone, across which the attackers must advance to the assault.

Herein, then, to my mind, lies the great advantage of heavy guns. We have in them a means of bringing the most effective artillery fire it is possible to obtain against an enemy in the field, and moreover, of bringing that fire under conditions in which field artillery cannot hope to compete, for field guns have not the necessary shrapnel power, if the shell is opened as high and as short as it can effectively be with heavy guns. But to obtain the full effect of this power, it is necessary (1) that the gun should be a high velocity one; (2) that the bullets in the shrapnel should be of sufficient size and weight; (3) that the shell should be opened up high in the air; how high it is difficult to say, for there is nothing more difficult than to estimate the height of burst of a shell some 5000 yards from the guns; but at a rough guess I should say that 100 or perhaps 150 feet or even more above plane would not be too much.

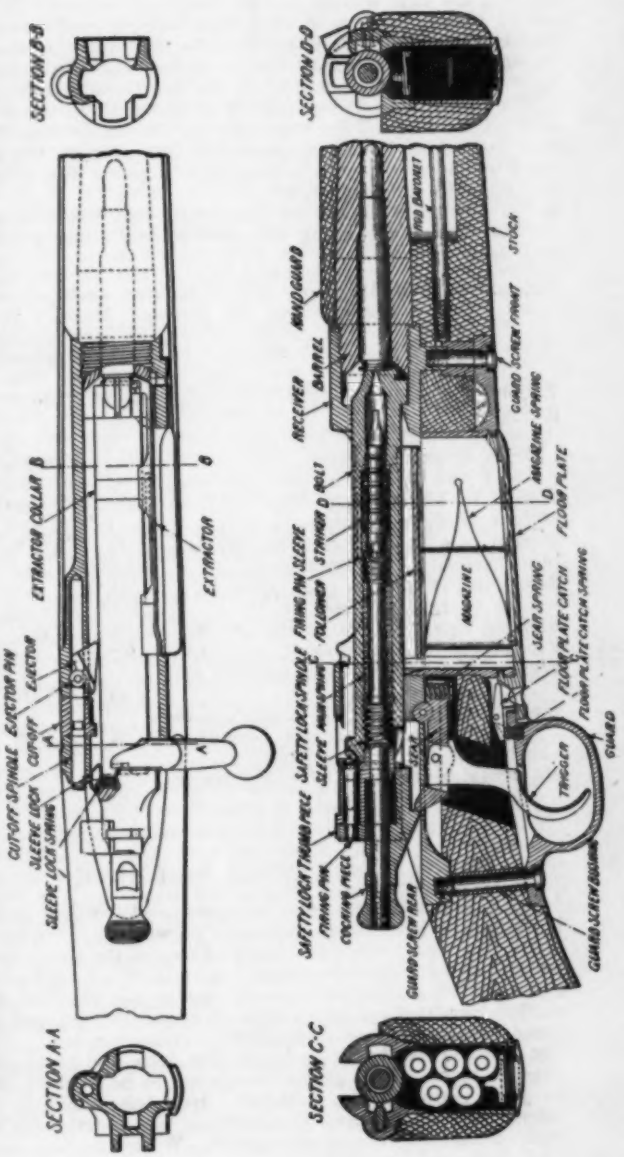
To put it in a few words. If modern conditions of fighting have brought about a great extension of the *personnel* of all arms, the object of that extension being to avoid the deadly effect of modern weapons,

then to counteract that extension of the *personnel*, modern fire must also extend, and the necessity for that extension is as great in the case of bullets coming from guns, as it is in the case of bullets fired from rifles. It is manifestly useless to put many shrapnel bullets close together, when the enemy is scattered, and the proposal I submit for consideration provides for an extension of the action of shrapnel otherwise unobtainable, while at the same time, if a more compact target should present itself, by the simple process of lengthening the fuse, a more concentrated fire would be obtained.

Artillery practice in warfare also brings before us another condition favorable to an extension of the area covered by our shell fire, and that is, the difficulty, which not unfrequently exists, especially at long ranges, of getting our shell to burst exactly where we would wish. A small error in this respect, in a wide spreading shell, matters less than in one having a more limited sphere of action. It is the local action of the lyddite shell that renders it generally of no value for work in the field. The less local the action of our shrapnel is, the greater, within reasonable limits, will its value be.

THE NEW SPRINGFIELD MAGAZINE RIFLE.—"The new Springfield magazine rifle," says the *Scientific American*, "which has undergone its preliminary tests with very gratifying results, will take the place of the Krag-Jorgensen, which now, for several years, has been doing excellent service in the United States Army. We present a photograph of the gun, which will be known as Springfield Magazine Rifle, Model 1903, and also a line drawing which shows several sectional views of the gun. By means of the carefully lettered parts a good idea is obtained of the details of the gun. The weapon is supplied with a cleaning rod, which can be partially pulled from its place below the barrel, and held with a catch so as to form a bayonet. The great advantage of the rod-bayonet is that it lightens the weight made up of the gun, bayonet, and bayonet's scabbard, and, by dispensing with the latter two as separate articles to carry, permits the soldier to carry with him an intrenching tool of sufficient size and weight to be serviceable. While there is some diversity of opinion as to the value of the rod-bayonet, which is considered to be less effective than the type now in use, it still is of value as converting the musket into a pike. Moreover, in view of the growing value of the intrenching tool and the ever-decreasing opportunities for the use of the bayonet, the substitution of an intrenching tool for the latter is certainly in line with the recent development of field operations. The piece is centrally fed by means of clips, each of which holds five cartridges; and it will be noticed that the bolt has two lugs instead of one as in the old gun. In the last report of the Chief of Ordnance the trials of the piece are spoken of as having given 'very satisfactory results.' The chief points of difference from the Krag-Jorgensen are this use of two lugs in place of one for holding the bolt against the rearward pressure of the powder—the increased strength so obtained being sufficient to allow of an increase of velocity with the same weight of bullet, from 2000 feet per second in the Krag-Jorgensen to 2300 feet per second in the new piece, the resulting increase in muzzle energy being from 1952 foot-pounds to 2582 foot-pounds. The Krag-Jorgensen is capable of penetrating 45.8 inches of white pine at a distance of 53 feet, whereas the new weapon penetrates 54.7 inches at the same distance. The striking energy at 1000 yards has been raised from 396 foot-pounds to 461. Other data regarding the new piece are as follows:

"The calibre is 0.30; the rifling is made up of four grooves of a depth of 0.004 inch, the twist being one turn in 10 inches. The bullet weighs 220 grains, which is the same as that of the Krag-Jorgensen, but the powder charge has been raised from 37.6 to 43.3 grains. In spite of the considerable increase in its power the weapon has been greatly reduced


SECTION B-B
EXTRACTOR COLLAR
EXTRACTOR
CUTOFF SPINDLE
EJECTOR PIN
EJECTOR
CUTOFF
SLEEVE LOCK
SLEEVE LOCK SPRING
SECTION A-A
SECTION D-D
RECEIVER
BARREL
HANDGUARD
MID BAYONET
STOCK
GUARD SCREW FRONT
MAGAZINE SPRING
FLOOR PLATE
FIRING PIN SLEEVE
STRIKER
STRIKER ROLL
FOLLOWER
MAGAZINE
SEAR SPRING
FLOOR PLATE CATCH
FLOOR PLATE CATCH SPRING
SAFETY LOCK SPINDLE
SAFETY LOCK THUMB PIECE
SLEEVE
SEAR
TRIGGER
GUARD
FIRING PIN
COCKING PIECE
GUARD SCREW REAR
GUARD SCREW BUSHING
SECTION C-C

in weight, for while the present service magazine rifle weighs 10.64 pounds, and the Mauser 10.5 pounds, and the German military rifle 11.54 pounds, the new weapon weighs only 9.47 pounds. It follows, as a matter of course, that, with such high velocity and fairly heavy bullet, the trajectory is correspondingly flat, the maximum ordinate of the 1000-yard trajectory being only 20.67 feet as against 25.8 feet for the Krag-Jorgensen, 24.47 for the Mauser, and 23.73 for the German military rifle.

"In addition to those mentioned above there are other improvements, such as housing of the magazine in the stock directly below the chamber, instead of having it project at the side of the gun, and there are many changes of detail which both improve the rifle and cheapen and accelerate its production.

"In closing it should be mentioned that the new gun is considerably shorter than any existing rifle and is only slightly longer than the military carbine."

New Springfield Magazine Rifle compared with the Krag-Jorgensen, the Mauser, and the German Military Rifle.

	Springfield magazine rifle.	Service magazine rifle.	Mauser 7 mm. rifle.	German military rifle.
Calibre, inches	0.30	0.30	0.275	0.311
Rifling:				
Number of grooves	4	4	4	4
Depth of grooves, inch	0.004	0.004	0.0049	0.004
Twist, one turn in inches	10.	10.	8.66	9.45
Weight of bullet, grains	220	220	173	226.82
Weight of charge, grains	43.3	37.6	38.58	41.2
Weight of complete cartridge, grains	451.15	438.85	385.63	430.24
Initial velocity, feet per second	2300	2000	2200	2145
Remaining velocity at 1000 yards	958	901	895	906
Muzzle energy, foot-pounds	2581.6	1952	1857.4	2135
Striking energy at 1000 yards, foot-lbs.	447.9	396.2	397.4	413
Penetration in white pine at 53 ft., ins.	54.7	45.8	50.8	.....
Weight of rifle, including bayonet and scabbard, pounds	9.47	10.64	10.5	11.54
Weight of rifle, including bayonet, scabbard and 100 cartridges, pounds	15.91	16.91	16.18	17.68
Capacity of magazine, rounds	5	5	5	5
Maximum ordinate of 1000 yard trajectory, feet	20.67	25.8	24.47	23.73

STEAM TURBINES.

More Turbine Channel Steamers.—A further and highly important indication that the steam turbine is growing in favor for short distance express sea service lies in the fact that two of the four vessels just ordered by the Midland Railway Company for its Irish Channel service are to be turbine-propelled. The four vessels are to ply between the company's new port of Heysham, on Morecambe Bay, and Belfast, and are to be equal to a speed of 20 knots on a six-hours' continuous trial. They are to be 330 feet long, 42 feet beam, and 17½ feet deep, and of an estimated gross tonnage of 1900. Three of the vessels are to be built on the Clyde—one each by John Brown & Co., Limited, Clydebank; Caird & Co., Greenock, and Wm. Denny & Brothers, Dumbarton. The fourth will be built by Vickers' Sons & Maxim, Barrow-in-Furness. While the two vessels to be built at Clydebank and Greenock are to be fitted with reciprocating engines of the twin-screw triple-expansion type, the other two—those to be built at Dumbarton and Barrow—will be propelled by steam turbines—in all likelihood

of the Parsons' type—operating three lines of shafting, each line having a single propeller. There will be in each ship one single-ended and two double-ended boilers. These notable vessels have been designed by Professor J. H. Biles, of Glasgow University, and by his associated partner in such work, Mr. William Gray. All the building firms selected have had experience and good records in the building of high-speed vessels for short distance services, while in the case of Denny Brothers at least the turbine-propelled vessel is in specially experienced hands. The conditions of the contract in each case impose a guaranteed speed of 20 knots over a period of six hours' continuous steaming, and should the result in any of the cases fall short of that by half a mile per hour the vessel may be rejected. The four vessels are to be produced almost simultaneously, and their advent will afford such opportunity—to the Midland Company directors and their designers, at any rate—of comparing the two types of machinery under such uniform conditions as should shed a clear light on the important question of their relative merits from a technical as well as a commercial point of view.—*Engineer.*

The French first-class torpedo boat No. 293, which is in hand at M. Normand's establishment at Havre, is to be supplied with turbine motors by the Parsons Company, of Wallsend-on-Tyne. The speed is to be twenty-four knots, and the boat may be rejected if twenty-three knots should not be attained. The vedette boat Libellule, put in hand at the Forges et Chantiers, Havre, which was to be supplied with turbines upon the French system of Laval, with boilers of the Renard type, has not yet been delivered, although she was to have been completed more than three years ago. The reasons for the delay have not been stated.—*Army and Navy Gazette.*

THE PROPELLERS OF STEAM TURBINE SHIPS.—A fortnight ago we had occasion to refer to the value of research work that might be undertaken in the solution of the difficult question of the most suitable form of screw propeller for varying forms of ships, and we have now to record the general result of a suggestive series of trials which have been carried out with the steam yacht Emerald, built by Messrs. Alex. Stephen & Sons, Linthouse, Glasgow, and fitted by the Parsons Company with a set of steam turbines working three shafts. The Emerald was at first tried with Messrs. Parsons' usual system of five propellers—one on the central shaft and two on each of the side shafts. Naturally, however, the forward propeller on each side was not far from the skin of the ship, and it was found that this caused a disagreeable noise. It appeared probable also that these two forward propellers, from their position, were not working to advantage; and in consultation with Mr. Parsons, Messrs. Stephen & Sons suggested that they should be taken off altogether, and the ship tried with the three remaining ones. When this was done, the noise was got rid of, and even as regards speed the result was improved. Messrs. Parsons then made three new propellers, with which it was found the results were still better—and these are on the vessel now. We understand that a similar course has since been followed in the case of the Queen Alexandra, one of the two successful steamers now running on the estuary of the Clyde with remarkable regularity in speed. It will be remembered that the Emerald recently completed her voyage across the Atlantic with splendid results, and her advent has excited considerable interest owing to the innovations embodied in her design, as well as to the historical fact that she is the first steam turbine-driven screw steamer to make the trans-Atlantic trip.—*Engineering.*

It really looks as though the new propellers are going to do for ships what caps and increased velocities have done for guns. The Essex on her first trials could not reach her 23 knots—with the new propellers she reached 24.8. This is more than any destroyer can reach out at sea.—*Engineer.*

THE FUTURE OF THE STEAM ENGINE.—The five years' extension of his patent of April 23, 1884, granted to the Hon. A. C. Parsons has now expired, though in view of the originality of his invention and its probable commercial importance in the future, few, we think, would maintain that the patentee has been able to reap an adequate reward for knowledge and skill, notwithstanding the extended life of his patent. Fortunately, in this instance the inventor had capital at his command, as a poorer man would probably have ruined himself in the struggle to overcome the—at that time—well-founded prejudices of engineers against any departure from the well-tried type of reciprocating steam engine.

Lord Kelvin has described the invention of the Parsons turbine as the greatest advance made in steam engine practice since the time of James Watt, and it is of interest to note that just as Watt was fully abreast of the science of heat, as understood in his day, so the creator of the compound steam turbine was also well equipped with theoretical knowledge, having been twelfth wrangler in 1876, and in addition to this, like James Watt again, was also a very capable mechanic. Indeed, the advance made required constructive ability of a high order, combined with a competent knowledge of the properties of steam and the theory of the ordinary water turbine. The multiple-expansion reciprocating engine, the other great discovery in steam engine practice made last century, belongs, on the other hand, to a different class of improvement, the invention being in the nature of a lucky accident, since the inventor introduced the system solely to meet certain mechanical considerations, and without any expectation of economizing steam. It was the fact that for many years no rational explanation of the economy of the compound engine was possible, which made so many makers of high-class Corliss engines slow to introduce the principle into their own practice. This explanation was finally arrived at by the detailed study of the indicator diagram, rendered possible by Regnault's experiments. This study showed that at the point of cut-off the steam present in the cylinder was often not more than 50 per cent of the total feed. When the significance of this fact was grasped, high-class engine builders commenced to compound their engines, with the result that the steam consumption of these was reduced from over 18 pounds per indicated horsepower per hour to well under 12 pounds. Engineers are sometimes, in regarding the magnitude of their own achievements, tempted to ignore the help they have received from the physicist; but though it is quite true that the results of the indicator analysis above mentioned are now applied daily by many quite incapable of making it themselves, their debt to Regnault remains, just as that of the draughtsman who uses a table of circle areas does to the dead-and-gone mathematicians who first succeeded in approximating to the value of π.

As matters stand, the master-feature of the Parsons turbine is now open to the whole British manufacturing world, and incidentally is likely to afford it an excellent object-lesson in the practical value of some acquaintance with elementary thermodynamics. Many excellent engine-builders, having by a system of trial and error succeeded in building capital steam engines of the ordinary type, will now find their accumulated experience valueless to them if they enter the new field; and lacking the guidance of the theta phi diagram, or its equivalent, may find themselves like mariners afloat on a strange sea without sextant or compass. That they must sooner or later adventure the voyage seems very probable, unless they content themselves with building the smaller class of prime mover for which the turbine seems less well adapted than for larger units. The makers of large reciprocating engines will, it is true, have another course open to them, in that they can take up the manufacture of internal-combustion engines, which promise to be in the future the principal competitor of the steam turbine in the economical production of power on a large scale. The change, however, from the manufacture of high-class steam engines to the building of large gas engines will also involve the "scrapping" of much valuable experience.

Nevertheless, where an adequate fall of water is unavailable, the large power-stations of the future will, it would seem, be almost certainly equipped with either steam turbines or gas engines. The latter have, of course, certain advantages from a thermodynamic point of view, but require a large staff to look after them. It is true that of late years some remarkable results have been obtained with the ordinary type of steam engine, operated with superheated steam, but these are in no way better than similar results obtained with large turbines, as may be shown by the fact that Messrs. Brown, Boveri & Co., in the case of a 10,000 horsepower turbine, now on order for Frankfort, have guaranteed a steam consumption of 15.4 pounds per kilowatt hour, which is claimed to be equivalent to 8.8 pounds per indicated horsepower hour. One objection may properly be taken to many statements as to steam consumption, which are often impossible to compare one with the other with absolute fairness, since this steam consumption is reckoned at boiler pressure instead of being reduced to "from and at 212 deg." It is thus not easy to make a really accurate comparison between engines using steam under different conditions. The engine taking steam at the higher pressure gains an advantage over and above that legitimately due to its greater temperature range. As matters stand, however, the pressures used in turbine plants are practically the same as in the case of modern reciprocating engines, being fixed by the type of boiler used. Dr. de Laval, it is true, has driven his turbines with steam generated at pressures of 1600 pounds per square inch or more—a feat which it would not be easy to parallel with a reciprocating steam engine; though it must be borne in mind that somewhat similar pressures are reached in the Diesel oil-engine, which is of the reciprocating type.

Whilst, however, the reciprocating engine can apparently compete with the turbine in the matter of steam economy, in every other respect the advantage seems to rest with the newer motor. The Turbinia gave one a striking object-lesson in this regard. With an ordinary type of torpedo-boat destroyer running at high speed, the whole floor of the engine soon becomes flooded with oil, which certainly constitutes an excellent example of the truth of Palmerston's definition of dirt as matter in the wrong place. With turbine machinery there is no difficulty in keeping the engine room clean, and the staff there has certainly its labors much reduced. In spite of the 8000 horsepower on board the Queen, there is nothing whatever to see in the engine room. The lubrication is automatic, and the greaser, of such importance on board sister vessels of the same service, has little or nothing to do. Even in the less strenuous conditions of central-station practice, the saving in oil as compared with a reciprocating engine is equivalent to a saving of at least 1 pound of steam per indicated horsepower hour, whilst at the same time the staff may be reduced by a half, if not more. With these advantages, it is certain that large engine-making firms will, as suggested above, be compelled in self-defense to take up the manufacture of this class of prime mover. Already several firms have done so. In this issue we give an account of two turbine steamers which are being built by Messrs. Vickers, Sons & Maxim, and by Messrs. William Denny & Brothers for the Midland Railway. The British Westinghouse Company is preparing to build large turbines for electric stations, and also Messrs. Willans & Robinson, Limited, while two firms at least on the northeast coast are entering into the manufacture of steam turbines. By the aid of these firms and others it is probable that a number of valuable improvements of a minor character may be effected.

An interesting modification of the Parsons turbine is now being put on the market by the General Electric Company of America. In the Parsons turbine the pressure varies continuously as the steam passes through successive series of blades. The type may therefore be considered to be a compound "pressure" turbine. It is, however, quite pos-

sible to apply the compounding principle to an impulse turbine of the Girard type, or, as we are speaking of steam, we should perhaps say of the de Laval type. This idea seems to have originated with Mr. Ferranti, whose patent is numbered No. 2565, of 1895. The same idea, probably quite independently, was taken up by Mr. C. G. Curtis, of New York, whose earliest English patent is dated September 1, 1896. There is, however, a long road to be travelled before a good patentable idea is satisfactorily converted into solid metal, and so far as we are aware, Mr. Ferranti never made the attempt, being probably too much occupied with other matters. Mr. Curtis was, however, more persistent, and succeeded in interesting the powerful General Electric Company, of Schenectady, who, after much experimenting, are now putting on the market compound-impulse steam turbines of very large size, which it is claimed show a very high efficiency. One advantage of this type lies in the fact that it is unnecessary to admit steam over the whole circumference of the turbine. In fact, the Curtis steam turbines can be constructed as "partial-admission" turbines. The diameter of the rotor may therefore be comparatively large even for units of no great size, and the speed of rotation may be correspondingly reduced; with a pressure turbine, on the other hand, the size of the rotor is somewhat rigidly connected with the power to be exerted, as the steam must be admitted over the whole circumference of the wheel.

The governing of an impulse-turbine is similarly a more simple matter than the corresponding problem in the case of a pressure turbine. It is merely necessary to reduce the arc of the rotor through which steam is admitted. In the original de Laval type several nozzles played on the same wheel, and as the load fell these were shut off one by one, reducing the expenditure of steam and the power delivered in a corresponding degree. Quite a similar arrangement in principle, though differently worked out, has been adopted in the case of the Curtis turbine. The largest size for which designs have yet been got out is rated at 5000 kilowatts. The speed in this case is 514 turns per minute, and it is claimed that the steam consumption on full load will not exceed 19¾ pounds of steam per kilowatt hour. The axis of these turbines is vertical. The load on the footstep is simply that due to the weight of the rotor, and this footstep is lubricated by oil supplied under a pressure of 250 pounds per square inch. In order to prevent damage in case of a failure of the oil supply, provision is made for automatically shutting off the steam should the pressure in the oil pipe fall below a certain limit.

It will be seen that the efficiency reached by this type is not yet as high as has been attained by Messrs. Brown, Boveri & Co. with large compound pressure turbines of the Parsons type. But the construction of compound-impulse turbines is still in its infancy, and there is no reason to suppose that with greater experience better results will not be obtained; though even as matters stand, the steam consumption guaranteed by the General Electric Company closely approaches the best figures given by engines of the ordinary type, being equivalent to little over 11 pounds per indicated horsepower; and, taking in account the saving possible in lubrication and labor, these turbines probably make at least as good a showing from the commercial standpoint as that of the very best reciprocal engines, though we note that Mr. Charles T. Porter, to whom the practice of mechanical engineering is already so deeply indebted, is prepared to guarantee a consumption of under 9 pounds of steam per indicated horsepower hour for engines built to his designs. His system comprises the use of steam at a pressure of 300 pounds per square inch, superheated by 200 deg. Fahr. or more. The designed speed is 600 revolutions per minute for a piston speed of 2000 feet per minute. It should also be noted that Messrs. Easton & Co., who are the British licensees for the Schmidt superheater, are also prepared to guarantee an exceptionally small steam consumption for their engines.

Coming back to the Curtis steam turbine, it is very improbable that the highest economy possible with these has yet been reached. In some respects the type has a mechanical advantage over the Parsons turbine, in that the clearance can be somewhat larger; but it must be admitted that hitherto no difficulty has yet arisen in the pressure turbines from the smallness of the clearance allowed.—*Engineering*.

THE FLEET MANŒUVRES.—The following are the material parts of the official programme of the fleet manœuvres issued by the Admiralty:

The Composition of the Fleets.

"B" FLEET.

Vice-Admiral Sir A. K. Wilson, V. C., K. C. B.

"B 1" FLEET.

Battleships.	*Cruisers.*
Revenge (Flag),	Good Hope (Flag),
Empress of India (Flag),	Drake,
Royal Oak,	Sutlej,
Royal Sovereign,	Hogue,
Hood,	Edgar,
Benbow,	Hawke,
Sans Pareil,	Dido,
	Venus,
	Melampus,
	Latona,
	Apollo,
	Andromache,
	Æolus,
	Medea,
	Medusa.

"B 2" FLEET.

Battleships.	*Cruisers.*
Majestic (Flag),	Europa.
Magnificent (Flag)	Doris,
Mars,	Hermes,
Jupiter,	Minerva,
Hannibal,	Rainbow,
Prince George,	Sappho,
Repulse,	Prometheus.
Ramillies.	

"X" FLEET.

Admiral Sir Compton Domvile, G. C. V. O., K. C. B.

Battleships.	*Cruisers.*
Bulwark (Flag),	Bacchante (Flag),
Venerable (Flag),	King Alfred,
London,	Aboukir,
Formidable,	Powerful,
Implacable,	Imperieuse,
Irresistible,	Diadem,
Russell,	Spartiate,
Exmouth,	Blake,
Cæsar,	Diana,
Illustrious,	Gladiator,
Renown.	Vindictive,
	Hermione,
	Naiad,
	Intrepid,
	Iphigenia,
	Spartan,
	Scylla,
	Pandora,
	Pioneer,
	Pyramus,
	Pegasus.

General Remarks.—The manœuvre area is unrestricted except as regards the territorial waters of France and Spain, his Majesty the King of Portugal having given permission for the use of his territorial waters for manœuvre purposes. The manœuvre fleets will be known as "B" Fleet and "X" Fleet, the former being divided into "B 1" and "B 2." The composition of the fleets will be approximately as shown above The two fleets will be distinguished from each other by the ships of "B" Fleet keeping two "not under control" balls hoisted vertically on the triatic stay about half way between the fore and main masts, night and day. As these balls are intended to provide means for mutual identification at a distance between the vessels of the opposing sides, such as would naturally be the case between the vessels of hostile nations in war, these distinguishing balls are, on no account, to be hoisted by any vessel belonging to "X" Fleet, nor hauled down at any time by those of "B" Fleet. "B 1" Fleet is concentrating in the Channel ports, England and Ireland being "B" territory. "B 2" Fleet is concentrating at Madeira, which is also "B" territory. "X" Fleet is concentrating at

Lagos, which, together with the coast of Portugal and Gibraltar, is "X" territory.

General Idea.—The contest for the command of the sea between the two maritime countries, "B" and "X," has been in progress for some time. In the waters approximately between Gibraltar and Madeira "X" has been victorious, and "B" driven, with loss, into his defended port at Madeira. In northern waters, however, "B" has so effectually disposed of the enemy's fleet that he is able to despatch a force ("B 1") to the south for the purpose of combining with his available forces at Madeira ("B 2") and then engaging "X," known to be concentrating at Lagos. The Admiral in command of "B 1" has given his junior, the Admiral commanding "B 2," the necessary instructions by cable. The Admiral commanding "X" Fleet, while still preparing for sea at Lagos, hears from reliable sources by cable that two squadrons belonging to "B" have sailed from their home ports, obviously with the intention of joining at sea and effecting a junction further south with the fleet known to be preparing for sea at Madeira. "X" battleships are ready for sea 20 hours after "B 1" has sailed, and "X" has had reliable information that "B 2" battleships are at that time still refitting. Both "X" and "B 2" cruisers are, however, ready for sea at the time when "B 1" Fleet sailed—*i. e.*, 8 a. m., 5th August.

General Instructions.—The operations will commence at 8 a. m. on 5th August, when the vessels of "B 1" Fleet will sail for a rendezvous to be determined by the Admiral commanding "B Fleet." The "X" cruisers will be free to sail at 8 a. m. on 5th August, the battleships 20 hours later—*i. e.*, 4 a. m., 6th August. "B 2" cruisers are free to sail at 8 a. m., 5th August. The "B 2" battleships are to be ready to sail at such time as the Admiral commanding "B Fleets" may direct after noon on 6th August. On the conclusion of the operations all ships will proceed to Lagos. The Mediterranean, Channel, and Home Fleets, and Cruiser Squadron will then carry out tactical exercises. All specially commissioned and completed vessels will return to England, carrying out target practice under the orders of the senior officer during the passage. One-half of a quarter's allowance of ammunition is to be expended from the heavy, light, Q. F., and machine guns of the vessels specially commissioned. When the target practice has been completed, these vessels will proceed to their respective ports, where the ships specially commissioned will be inspected by the Commander-in-Chief and be paid off.

Rules and Regulations.—No rules setting forth the conditions under which ships will be put out of action will be issued. Each case must be decided by the umpires on its merits, on the basis of what would be probable in war. When two or more ships come into action, the commencement of the engagement is to be marked by the firing of a gun by one of the ships engaged. During the engagement single guns are to be fired at about one-minute intervals by the ships engaged, and a careful record of gun-fire, etc., is to be made on the forms supplied. When either side considers that he has beaten the other, he should signal "Propose reference to umpires." If the other agrees to the reference, the action is to cease. If the other does not agree, the action may continue, but not for more than a reasonable time, say, one hour, which is to be determined by the senior officer present. When reference to the umpires has been agreed upon, the senior officer present is to determine what ships on either side are to proceed into port to await their decision, pending which the ships detached are to be considered out of action. The senior officer present must take care to select, as far as possible, equitably from both sides. If a ship is undoubtedly torpedoed or manifestly overpowered by a much superior force, the senior officer present may take the responsibility of temporarily putting such ship out of action, and order her into port for the decision of the umpires. In this case it will not be obligatory to order into port a ship from the opposite side. Ships put out of action

can take no further part in the manœuvres, but must return to Lagos flying the blue peter at the fore. They are to select a route as far as possible clear of the scene of operation, and are strictly enjoined not to communicate any information to the ships on either side which they may meet on the way. Should the Admiralty desire to communicate with the fleets during the progress of "hostilities," and their instructions be conveyed by a ship attached to either of the opposing forces, or by any other ship, such a ship is to display the signal "A. K. H." It will thus be known that she is acting under Admiralty orders, or is about to deliver despatches or telegrams, or to signal orders received from the Admiralty, and the respective admirals and senior officers are to take the necessary steps to ensure that the orders so communicated are forwarded and acted on without delay. If the commanding officer of one vessel sights another flying the signal "A. K. H.," he is at once to close her so as to place himself at a convenient distance for communication by signal, should it be necessary. Colliers are not open to attack at sea. During the operations ships are not to enter foreign territorial waters, except those of Portugal.

Torpedo Craft Manœuvres, 1903.—The following rules were issued by the Admiralty:

1. These rules have been drawn up for the guidance of all who may be employed in the 1903 Torpedo Craft Manœuvres, and are to be used by the umpires in giving their decisions. In the event of questions arising which the rules do not provide for, the umpires will decide as they think fit.

2. The Blue Side territory extends from Malin Head to Brow Head inclusive on the east coast of Ireland, and Carrickfergus, Kingstown, Waterford, Lundy Island, and Queenstown are to be considered as defended Blue ports, each of which except Lundy is the headquarters of a flotilla. No Red vessel of any kind is to enter the limits of the first four of these ports at night, or approach within 8000 yards of those limits by day. The limits are to be defined as follows: Carrickfergus—A line drawn from Kilroot Point to Grey Point. Kingstown—A line joining the outer extremities of the breakwaters. Waterford—A line from Hook Point to Red Head. Lundy Island—The circumference of a circle having a radius of two miles, with its centre at the War Signal Station. Queenstown may be entered for the purpose of attacking the Blue cruiser lying inside, subject to the risk of being put out of action, as provided for in Arts. 10 (*a*) and 12. The shore defenses here will be actually manned.

3. The Red Side territory extends along the West Coast of Great Britain from the Mull of Cantyre to the Scilly Islands, inclusive, and Loch Ryan, Holyhead, Milford Haven, and the Scilly Islands are to be considered as defended Red ports. No Blue vessel is to enter the limits of these ports except Milford Haven, or approach within 8000 yards of those limits by day. The limits are to be defined as follows: Loch Ryan—A line drawn from Finnart Point to Milleur Point. Holyhead—A line drawn from the outer extremity of the breakwater to Clipera Point. Scillys—The circumference of a circle with a two-mile radius having its centre at Stevel Point, the western extremity of St. Mary's Island. Milford Haven may be entered for the purpose of attacking Red ships inside, except the depot ship, subject to the risk of being put out of action, as provided for in Arts. 10 (*a*) and 11 (*a*). The shore defenses here will be actually manned.

4. "Hostilities" will commence at midnight on August 2-3 and end at noon on August 8. At the commencement the disposition of the contending forces will be as shown on the attached list, but when war has been declared all vessels may leave their ports and be moved as the officers in chief command on each side think fit, except the depot ships, which are to be considered as fixed bases.

5. The object of the Red side will be to torpedo the four Blue cruisers. As these vessels are supposed to represent part of a larger cruiser force out of reach, which can substitute other ships for them if destroyed, the effort is to be made every 24 hours counting from noon to noon, commencing at noon on August 3; and when successfully attacked they are only to remain out of action till the noon following. The object of the Blue side will be to render the sea safe for Blue cruisers, by putting as many of the Red side out of action as possible in the time at their disposal. On both sides, however, the operations must be considered as an experiment to ascertain the conditions of torpedo craft warfare, as far as is practicable in peace manœuvres, and not as a question of defeat or victory for either side.

6. For the purposes of identification, especially during night engagements, each gunboat, destroyer and torpedo boat will be given a secret number or letter known only to her own side and the umpires. This number is to be painted in white letters on a black ground on boards on each side of the funnels, and another showing aft over the taffrail, in figures of such a size that they can be deciphered with the aid of a glass at night from a distance of two cables when carried by a torpedo boat or Red destroyer, six cables by a Blue destroyer, and eight by a gunboat. The successful deciphering of the number by a ship of the opposing side is supposed to establish the fact that the latter has succeeded in getting within range for a sufficient period to put the vessel bearing the number out of action, if of inferior power. Care is to be taken that these numbers are in no way concealed or obscured.

7. For the purposes of the manœuvres the gun vessels Curlew and Landrail are to be considered as cruisers. These ships, together with the Isis and Aurora, are to provide the special objective of the Red side, and of the four, three will be always under weigh in the water space separating Red and Blue territory, each of which will be within 30 miles of the outer limits of a separated Red "defended" port every night from 10 p. m. till 2 a. m. during the manœuvres, except on the night of August 2-3. The fourth will be at anchor outside the southern limit of the man-of-war road in Queenstown Harbor. All four ships are to be considered as open to attack wherever they may be. Where the 30-mile radius from Loch Ryan overlaps the limits of the Blue defended port at Carrickfergus, the cruisers will remain outside the latter.

8. All destroyers on the Red side are to be considered as torpedo boats, in order to represent an enemy strong in that class of vessel. For this purpose they are to be restricted to the use of half boiler power only, and they are never to fill up to more than two-thirds of their total coal capacity.

9. A cruiser can put an indefinite number of the opposing ships out of action subject to the conditions below, but can only be put out of action herself by being torpedoed, or by getting within 8000 yards of the entrance to a hostile defended port. To successfully torpedo her a vessel must get within 600 yards and fire a Very's light before being discovered if the cruiser is under weigh, or within 1000 yards if she is at anchor.

10. A gunboat is to be considered as equal to 4 destroyers or 16 torpedo boats, unless her fighting power has been reduced as provided for below in paragraph *c*. A gunboat is to be put out of action:—*a*. If within 3000 yards of a hostile cruiser for five minutes by day, which in all cases is to mean between 3 a. m. and 9 p. m., or if her secret number is deciphered by a cruiser, depot ship, other gunboat, or shore defenses at any time. *b*. If within 2000 yards of one hostile gunboat for 15 minutes by day, or if her number is deciphered by the same at any time. In this case the two ships will put each other out of action. *c*. If within 2000 yards of two hostile gunboats for 10 minutes by day, or if her secret number is deciphered by both at or about the same time at night. In this case each of the two hostile ships will have her fighting power reduced by 50 per cent

for the remainder of the manœuvres. *d*. If within 2000 yards of three or more hostile gunboats by day, or if her secret number is deciphered by all three at, or about, the same time at night. In this case none of the three hostile ships shall be put out of action, or suffer reduction of fighting power. *e*. If she has successfully claimed 4 destroyers or 16 torpedo boats.

When an aggregate number of 4 destroyers or 16 torpedo boats has been successfully claimed by the gunboats of one side, but no individual gunboat has claimed that number alone, one of the gunboats is to be selected by the umpires as out of action, the choice depending upon the merits of the case, and in general upon the ship that has successfully claimed most. This is to be repeated for every 4 destroyers or 16 torpedo boats so claimed. *f*. If she gets within 8000 yards of the limits of a hostile defended port by day.

11. A Blue destroyer is to be considered the fighting equivalent of 4 torpedo boats, but a Red destroyer is to be considered as a torpedo boat only in all respects. A Blue destroyer will be put out of action:—*a*. If her secret number is deciphered by a gunboat or depot ship, or by the shore defenses. *b*. If within 2000 yards of a gunboat for 5 minutes by day. *c*. If she has successfully claimed 4 torpedo boats.

When an aggregate number of 4 torpedo boats has been claimed by the Blue destroyers, but no individual destroyer has claimed that number on her own account, one of the destroyers is to be put out of action in the same way as in the similar case of the gunboats dealt with in Article 10. *d*. If she gets within 8000 yards of the limits of a hostile defended port by day.

12. A torpedo boat or Red destroyer will be put out of action:—*a*. If her secret number is deciphered by any of the opposing side, including Queenstown shore defenses. *b*. If under the searchlight of a Blue cruiser for 1 minute by night before firing her torpedo at the latter. *c*. If within 2000 yards of a cruiser for 1 minute, or a gunboat or destroyer for 2 minutes by day.

13. Depot ships are supposed to represent fixed shore bases and are not therefore to be liable to attack, but they may use their searchlights to detect hostile vessels watching the entrances to their ports at night, and vessels whose numbers may be deciphered in this way will be put out of action.

14. Vessels while engaged are to fire blank from a light Q. F. gun at the rate of two rounds per minute. When a torpedo attack is made, a Very's light is to be fired at the moment when the torpedo would be discharged, all adjustments, etc., having first been most carefully made. No vessel is to fire more lights than the number of torpedoes she is actually carrying. All vessels are to have their full complement of torpedoes on board.

15. Claims against the enemy are to be made, firstly, by signalling or hailing to the ship claimed; and, secondly, by telegraphing direct to the umpires through any signal station or telegraph office on the claiming ship's side. The telegram is to state clearly the hour at which the engagement took place, the Article in the Rules under which the claim is made, and the secret number of the ship claimed if deciphered. Officers in chief command on each side will make their own arrangement for the despatch of vessels to convey the claims of their flotillas, when the latter are too distant to communicate directly with their own signal stations, and generally for the maintenance of communication between the flotillas at sea and the headquarters. When the umpires have decided on a claim the result of their decision is to be telegraphed without loss of time to the officer in chief command on each side in all cases, and these are to intimate the same by telegraph to any vessels on their own side which may be put out of action by the decision. Vessels out of action are to proceed forthwith to Milford Haven or Queenstown, according as they belong to Red or Blue side, and will remain out of action till the close of the

manœuvres, except in the case of cruisers which will be as given in Article 5. While under weigh for these ports they will fly Z flag by day, and carry navigation lights at night.

16. The use of lights at night will be optional on both sides except for ships out of action, but every precaution is to be observed to prevent accidents.

17. A list of the forces taking part, and their general disposition at the commencement of the manœuvres, is attached hereto.

Disposition of Forces.

BLUE SIDE.—In chief command, Captain C. G. Dicken; staff, Commander R. Hudleston, Assistant Paymaster L. F. Vizard; headquarters, Calliope, Kingstown; cruisers, Isis, Aurora; gun-vessels, Curlew, Landrail.

Belfast Flotilla.—In command, Captain H. L. Tottenham; depot ship, Conqueror; torpedo gunboat, Hebe; destroyers, Haughty, Cheerful, Sunfish, Ranger, Salmon, Roebuck, Racehorse, Avon, Havock.

Kingstown Flotilla.—In command, Captain A. Dodgson; depot ship, Calliope; torpedo gunboat, Spanker; destroyers, Sylvia, Syren, Shark, Fervent, Porcupine, Lightning, Star, Hunter, Zebra, Starfish.

Waterford Flotilla.—In command, Captain C. F. Thursby; depot ship, Cleopatra; torpedo gunboat, Skipjack; destroyers, Gipsy, Fairy, Falcon, Skate, Sturgeon, Contest, Osprey, Leven, Daring, Decoy.

Queenstown Flotilla.—In command, Captain E. F. B. Charlton; depot ship, Black Prince; torpedo gunboats, Grasshopper, Sharpshooter; destroyers, Ferret, Express, Lively, Sprightly, Vigilant, Leopard, Tiger, Vixen.

RED SIDE.—In chief command, Captain G. Le C. Egerton, C. B.; staff, Commander G. L. Sclater; headquarters, Devastation, Holyhead.

Loch Ryan Flotilla.—In command, Captain W. de Salis; depot ship, Mersey; torpedo gunboats, Niger, Seagull; destroyer, Teazer; torpedo boats, Nos. 34, 45, 51, 52, 53, 55, 57, 58, 80, 85, 87.

Holyhead Flotilla.—In command, Captain W. O. Boothby; depot ship, Devastation; torpedo gunboats, Renard, Antelope, Gleaner; destroyers, Recruit, Vulture, Petrel, Brazen, Dove, Electra; torpedo-boats, Nos. 25, 26, 33, 41, 42, 49, 59, 65, 67, 68, 71, 72, 76, 77, 78, 79, 82, 86, 109.

Milford Flotilla.—In command, Captain A. J. Horsley; depot ship, Northampton; torpedo gunboats, Sheldrake, Gossamer; destroyer, Bullfinch; torpedo boats, Nos. 98, 99, 107, 108, 110, 111, 112.

Scillys Flotilla.—In command, Captain J. de C. Hamilton; depot ship, Dreadnought; torpedo gunboats Alarm, Onyx, Speedwell; destroyers, Success, Flirt, Greyhound, Lee, Violet, Kestrel, Wolf, Lynx, Hasty, Opossum, Angler, Mermaid, Spitfire, Charger, Arab, Ostrich.

Umpire Staff.—Chief Umpire, Rear-Admiral E. F. Jeffreys; umpires, Captain J. de M. Hutchison, Captain R. S. Phipps Hornby; secretary, Commander C. R. N. Burne; headquarters, Queenstown.

MANŒUVRES.

The correspondent of the *Daily Telegraph* on board of the Good Hope, writing from Lagos Bay on August 12, says: In company with the Drake, Sutlej and Hogue, after thirty-three hours' exhausting labor in coaling ship and taking stores, we started from Portland on August 5, four of the newest and most powerful armored cruisers afloat, the slower light cruisers following in our wake, and then steering another course to pry on the enemy. Unfortunately the Sutlej early developed a hot bearing, and when later a cylinder cover began to leak she fell astern. Until Friday our three ships continued steaming eighteen knots, and then the Drake was forced by a hot bearing to slow down. None of the ships

had any trouble with their Belleville boilers. The Good Hope and Hogue steamed at eighteen knots for 73½ hours, covering 1331 knots. This brought us to the rendezvous. On approaching it on Saturday morning we should have crossed the track of Vice-Admiral Beresford, and, true to anticipations, we did. We met Wilson about six o'clock on Saturday evening, and then Beresford—splendid testimony to our steaming efficiency this. Meantime a large cruiser, at some distance, crossed Wilson's bow. He signalled to the Good Hope and Hogue to give chase, specifying the ship as the protected cruiser Spartiate. Instantly the Good Hope's engines, then going at eight knots, increased their pace, and a most exciting chase began, which appealed not less to officers and men above than to the tired stokers and engine-room staff below. Their sporting instincts were aroused, and in eight minutes the Good Hope was ripping up the dark blue waters at a speed of nineteen knots an hour. As the Good Hope was far superior to the Spartiate, Admiral Fawkes ordered the Hogue, the gamest of steamers, though built for only twenty-one knots, to edge off on the port beam to cut off the foe if he attempted to escape. The chase began at seven, the enemy leading by nine or ten miles. In thirty-one minutes from the start the Good Hope was steaming twenty-two and a quarter knots, with a good deal in hand. As she drew up, the enemy made feints of attracting friends, and hoisted the Dutch and Red ensigns. By eleven o'clock, when the cruiser lay four or five thousand yards ahead, in the track of a brilliant moon, the Good Hope altered her course to give play to her full broadside of two 9.2-inch and eight 6-inch guns. The action lasted forty-four minutes. The Good Hope is one of the best gunnery ships in the service, and theoretically a murderous fire was concentrated on the foe. When it was concluded, that foe had been sunk several times over, while we had kept out of range of her earlier pattern 6-inch guns. Admiral Fawkes began to signal, intending to obtain an admission of defeat. "Who are you?" the enemy asked. In reply the Good Hope responded, "Who are you?" Then to our amazement came the answer, "Bacchante. Proceed to Lagos out of action. I will do the same." Misled by Admiral Wilson's signal, we thought we had been fighting a weak ship, which now turned out to be the flagship of Rear-Admiral Sir Baldwin Walker, slightly senior to Admiral Fawkes. Consequently we had been under the fire of a ship like ourselves, carrying two 9.4 guns, but four fewer 6-inch weapons. We believed we had won, nevertheless, but you cannot argue with a superior officer. Sorrowfully we hoisted the blue peter, the sign of out of action, and steamed towards Lagos Bay. We had the satisfaction of witnessing the combination of our battle fleets, and had cut off the ship which was bearing the news of the junction to the enemy's battle fleet. We have seen nothing of the enemy's battleships.—*United Service Gazette.*

The fleets engaged in the manœuvres arrived in Lagos Bay at noon on August 13, the operations being at an end. The victory is claimed for fleet "B," which was under the orders of Vice-Admiral Sir A. K. Wilson, V.C., but the decision of the umpires has yet to be given. The two divisions of "B" fleet succeeded in effecting a junction to the northwest of the Azores at eight o'clock last Saturday night. The fleet, then consisting of fourteen battleships, found the "X" fleet, under Sir Compton Domville, with ten battleships, on Sunday afternoon. A battle ensued, in which three ships of the "X" fleet were put out of action; but Admiral Domvile claims to have destroyed four vessels of his opponent, including Lord Charles Beresford's flagship, the Majestic. The spectacle of the fleets coming to anchor in Lagos Bay is described as superb. The King of Portugal was there in his yacht to receive the British admirals, and the ships fired a royal salute in honor of his Majesty.

It was announced from the Admiralty on Thursday night that the following telegrams had been received from the umpire-in-chief respecting the fleet manœuvres which have taken place in the Atlantic:

"Dated Aug. 12.—Bacchante returned. Reports witnessed junction of B 1 and B 2 fleets 75 miles north true from Fayal at about 7 p. m. on Aug. 8."

"Dated Aug. 13.—Good Hope and King Alfred arrived. Latter reports being present when the two fleets ('X' and 'B') met in latitude 39-40, longitude 26-27, and an action took place at 1 p. m. on Sunday—'B' fleet, 14 battleships and 14 cruisers; 'X' fleet, 10 battleships and 4 cruisers."—*Army and Navy Gazette.*

The torpedo manœuvres were brought to a close on Saturday. Reviewing the operations, the *Times* says:

"The Blues possessed a force consisting of cruisers, gunboats and destroyers, while the Reds owned only gunboats and torpedo boats, the destroyers given them having restrictions placed upon their speed and coal supply in order that they should also be assumed to be torpedo boats. There were also on either side depot ships, but these were merely to be considered as fixed bases, and took no part in the warfare. The Blue cruisers represented a watching force off the enemy's ports, and acted as the objective of the Red boats, three of them being sent to cruise in the hostile waters every night, while the fourth remained at anchor at Queenstown, and could therefore also be attacked. The protection of these cruisers was assigned to the Blue destroyers, and it was the object of the latter to put as many of the Red boats out of action as possible in the time at their disposal. The rules under which actions were to be fought are somewhat technical in character, and this has doubtless made it a little difficult to follow the results of the fighting from day to day; but they are presumably perfectly plain to the umpires whose business it was to administer them, and whose final report will doubtless be published in due course.

"So far as it is possible to gather at present, the Reds have succeeded in torpedoing three of the Blue cruisers—the Isis, off Loch Ryan on Tuesday night, the Curlew, off the Scillys, on Wednesday night, and the Isis again on Friday night in the man-of-war roads at Queenstown. A large number of destroyers and torpedo boats have also been put out of action as the result of the week's fighting. If we recall the analogy referred to above, the apparent success of the Red side might be held to indicate something lacking in British preparations for watching an enemy's ports and defending the Channel, or at least that the Blue destroyers were insufficient in numbers to cope with the torpedo menace. As, however, we are officially warned, it is not only from victories that lessons are to be obtained, and it is quite possible that students of this kind of warfare will draw some of their most valuable conclusions from the defeats and indecisive actions. Noteworthy, too, is the almost entire absence throughout the week of the reported breakdowns and mishaps to which we have been accustomed in previous manœuvres of this character. This satisfactory result is no doubt largely due to the circumstance that many of these small craft are constantly engaged in instructional work in connection with the flotillas attached to the three home ports, and it cannot fail to add materially to the public confidence in this class of war-vessels, shaken as that was a time ago by a series of disasters and losses."

The special correspondent of the *Daily Telegraph* says that, put briefly, the result of all the recent naval operations in the Irish Sea has been, from a merely competitive point of view: That Red side gained three cruisers, two gunboats, twenty-one destroyers, each equal to four torpedo boats. Blue side gained four gunboats, twenty-four torpedo-boats. The object of the manœuvres, however, has been to solve a great, a vital problem as regards not merely the maintenance of the empire in its present proud position, but of its very existence. On our side various methods of searching the seas have been tried, and what has been learned from the results has been of inestimable value. These manœuvres were the first

in which a fleet of small craft had been handled from headquarters on shore, and it is considered that the experiment proves a complete success.—*United Service Gazette.*

The result of the torpedo manœuvres was a little unexpected, since the torpedo boats of the Red side succeeded in scoring quite a number of victories. They managed to bag two cruisers at sea and one in Queenstown harbor. The last-named, however, is rather of the character of a manœuvre victory, and the result might well have been different if the projectiles had been in the guns. The lessons learned from the operations, however, are not so much connected with the three incidents we have mentioned as with the general events of the week. It is most satisfactory to note that there were scarcely any of those mishaps which have on previous occasions been so plentiful. In spite of the circumstance that bad weather prevailed during the greater part of the week, the boats were always at sea, always well handled, and always doing excellent work, and this is just as true of one side as it is of the other. It would be no advantage to attempt to draw any conclusion from the number of vessels put out of action by the rules on either side. The value of the manœuvres comes from the experience gained in many directions. The method by which the operations were conducted from one central office was novel, and appears to have worked admirably. The tactical arrangements also by which the Red boats were watched in their ports by the Blue destroyers also appear to have given satisfactory results. On the whole, it may be said that the torpedo boat craft manœuvres of 1903 have served their purpose in every respect.—*Army and Navy Gazette.*

The tactical exercises which followed the fleet manœuvres were carried out according to the following official programme:—Friday, August 14, Saturday, August 15, and Sunday, August 16.—Harbor. Coaling, etc. Monday, August 17.—At sea. "I. Z. 1." Vice-Admiral Lord Charles Beresford v. Rear-Admiral Custance. Tuesday, August 18.—Harbor. General exercise. Service rig sailing races. Wednesday, August 19.—At sea. "P. Z. 2." Rear-Admiral Fawkes v. Rear-Admiral Walker. Thursday, August 20.—Harbor. General exercise. Private rig sailing race. Friday, August 21, and Saturday, August 22.—At sea. "P. Z. 4." Admiral Domvile v. Vice-Admiral Wilson. Sunday, August 23.—Harbor. Monday, August 24.—At sea. "P. Z. 3." Rear-Admiral Poë v. Rear-Admiral Lambton. Tuesday, August 25.—Harbor. Wednesday, August 26.—At sea. Reduced fleets. Action between officers not in command:—Forenoon. Captain Winsloe v. Senior Captain Channel Fleet. Twenty-five battleships and thirty-eight cruisers, with all the Mediterranean torpedo flotilla, took part in the exercises. The whole purpose of these operations, which have been kept secret, has been to enable each of the eight admirals, present with the combined fleets, to have the opportunity of handling the great force in tactical evolutions to illustrate the individual qualities of each one. The admirals are Admiral Sir Compton Domvile, commanding the Mediterranean Fleet; Vice-Admiral Sir A. K. Wilson, V. C., commanding the Home Fleet; Vice-Admiral Lord Charles Beresford, commanding the Channel Fleet; Rear-Admiral Sir W. H. Fawkes, commanding the Cruiser Squadron; Rear-Admiral E. S. Poë, second in command of the Home Fleet; Rear-Admiral R. N. Custance, second in command of the Mediterranean Fleet; Rear-Admiral the Hon. H. Lambton, second in command of the Channel Fleet; and Rear-Admiral Sir Baldwin Walker, commanding the cruiser division of the Mediterranean Fleet.—*United Service Gazette.*

The manœuvres of the German fleet, which are now in progress, began with the concentration of forces at Wilhelmshaven on August 15. They are the most important which the Germans have yet held, not only because

of the great number of ships brought together, but because, with the exception of the Blitz and some vessels employed on despatch service, the whole of the ships belong to the new navy. Each division of the fleet is also homogeneous, the second division alone leaving something to desire on this head. For the first time the scouting vessels are brought together under a flag officer, Rear-Admiral Borckenhagen, who has ten cruisers under his command. The total number of ships taking part is forty-two, with 902 guns and 11,211 officers and men.—*United Service Gazette.*

WIRELESS TELEGRAPHY.

"WIRELESS" AND NAVAL WAR.—One of the most interesting aspects of the recent manœuvres has been the use made of wireless telegraphy. This summer, for the first time since the adoption of Signor Marconi's apparatus, the "wireless" (as it is universally termed afloat) was fitted to all the battleships of importance and to all the larger cruisers. Hence the reports on this system of communication as made by the correspondents afloat will have been followed with keen attention, at any rate by naval men. As pointed out by one correspondent, the instruments mainly in use in the royal navy differ materially from those used by Signor Marconi. The service instruments are largely from the design of Captain Jackson, R. N., although, of course, the principle of the Italian inventor has been retained as regards the main system. So far as can be judged from the unofficial reports, the service instruments worked satisfactorily, although in some ships the results were far better than in others. In selecting the cruiser Minerva for a specially difficult task, Lord Charles Beresford is said to have been influenced by the reliability of her wireless apparatus. He might have employed the swifter Europa to feel for the "X" fleet, and must have had some good reason for not doing so. The Minerva was ordered to place herself within forty miles of the enemy, and, whilst maintaining that distance, to endeavor (1) to discover the "X" code, and (2) if successful in that aim, to make misleading messages as to the course of the "B 2" main fleet. In effect, the Minerva was not able to pick up the enemy's secret code, and her mission failed. Her captain skillfully avoided capture, but there is no evidence that "wireless" proved of use on board the Minerva. As there was no correspondent on board this cruiser we cannot be sure about this, and further news would be interesting.

Again, when the "B 2" fleet sailed from Madeira, the vice-admiral directed that one-half his battleships should continuously make "X's" for a long period, and this was done to interrupt communications between the "X" cruisers and Admiral Domvile. Apparently this negative use of "wireless" proved successful, since we read in the narrative of a *Times* correspondent with the "X" fleet that the "X" cruisers employed in dogging Lord Charles Beresford communicated with Admiral Domvile for the most part by semaphore and flag. But these manœuvres were not required to establish the negative effect of "wireless." It is well established that fleets can mutually interrupt each other's signals. We do not find much evidence pointing to the positive utility of the wireless signalling during these manœuvres. Some minor instances there were, doubtless, but signals were always interrupted with ease when opposed cruisers lay within sixty miles of each other. Again, when no interruptions occurred, the maximum distance over which the wireless messages usually passed barely exceeded sixty miles. Of this there were ample proofs prior to the commencement of the "war," when the "B 2" cruisers, under Captain Ommanney, were steaming down to Madeira ahead of the main squadron. The only exception in this squadron, and even this was doubtful, was the receipt of a message from the detached Rainbow

at a distance estimated at ninety miles. Correspondents in the Bacchante and Good Hope mention that "wireless" carried messages considerably further than 100 miles. If messages were read clearly at distances above fifty or sixty miles in a few ships, then the case of these few merits special attention.

The inequality of the results indicates that the wireless system is capable of further development afloat. Whether the best results were due to certain sets of instruments, atmospheric conditions, or causes unknown is worth investigation. Again, it would be interesting to learn Signor Marconi's opinion of the Jackson instruments, which differ considerably from his own. Captain Jackson was engaged for some years in wireless experiments before Marconi was heard of in this country. Yet it does not follow that his instruments are superior. The service instruments, indeed, are a blend of several types; but the Jackson, we understand, predominates in the composition of the blend. In several cases, after the rival fleets had more or less solved each other's secret codes, false information flashed like slander through the "wireless" on both sides. Did these false messages produce any effect? It was impossible, in nearly all cases, to judge. One torpedo lieutenant in the "B" fleet is said to have falsely signalled to the "X" admiral on the morning of the battle that the course of Admiral Wilson was so-and-so. The reply, "Thank you," was received. But here, again, there is at present no proof that the information was believed or acted upon. Another reference, this time by a correspondent of the *Standard* is interesting. He says, in speaking of the use of "wireless," that the success of the Aboukir "with a timed system of communication" was very gratifying. What was this system? In this special case the interruptions of "B 2" were ineffective, and intelligence of the course that fleet had taken was conveyed to Sir Baldwin Walker at a critical time. Further developments of wireless telegraphy are in view. A system of limiting the range by means of "dampers" is still experimental, and information is wanting as to the benefits derived from the carrying of the wire to a great height by means of kites. These facts, however, indicate that the manœuvres have not been devoid of instruction.—*Army and Navy Gazette.*

An illustration of the uses of wireless telegraphy is furnished by the voyage of the Spartiate from Lagos to Plymouth, on the conclusion of the manœuvres. She brought home a number of invalids, and Captain Tate desired to receive early intimation of the wishes of the Commander-in-Chief at Plymouth. Consequently, while he was still over ninety miles from that port, he got into communication with the Rame Head, the nearest sea-coast signal station to Plymouth, and in answer to his request for orders, received Admiral Sir Edward Seymour's message. At the same time he was able to inform the Commander-in-Chief that he had invalids on board for Plymouth hospital. By these means the medical authorities had six hours for making necessary preparations and on the Spartiate reaching Plymouth Sound, a vessel went at once alongside to convey the patients ashore, and the Spartiate was able to resume her journey to Portsmouth.—*United Service Gazette.*

STEAM TRIALS.

THE WAR CONDITIONS TRIAL OF THE EUROPA AND SPARTIATE.—Last week the Hyacinth-Minerva Blue-book was on the *tapis*. Now that matter is eclipsed by the extraordinary performances of the Spartiate and Europa, more particularly by the latter. That these trials have rehabilitated the Belleville boiler is roundly asserted by that by no means inconsiderable party amongst the naval engineers which professes itself perfectly satisfied with the condemned boiler.

These two Belleville cruisers, they point out, "have each made a 20,000-mile trip, the second half of which was done under trying war conditions in the tropics and against adverse weather. The ships are now lying in Portsmouth Harbor, with no defect worth mentioning. No other boilers have ever done anything like this."

There is no getting away from this fact. Other types may do it, but none so far have been so tested. Indeed, till this trial was made, no real "war tests" have been attempted. The boiler committee's exhaustive trials have been rather of a scientific nature than a rough-and-ready war test; and it is not impossible that now and again the scientific aspect of the question has come unduly to the fore. This has perhaps been most evident in the matter of water consumption; but of this later.

The Spartiate and Europa are usually spoken of as sister ships. This is incorrect, for the Europa is an earlier and inferior example of the Diadem class, to which both vessels nominally belong. Her designed horsepower is 16,500 and 20.25 knots her speed, against 18,000 horsepower and 20.75 knots in the Spartiate. The Spartiate has Bellevilles of the usual type; the Europa boilers are identical almost with those of the Powerful and Terrible, though economizers were added as an afterthought. She was engined by Clydebank; the Spartiate has Maudslay engines. These last are particularly liked in the British navy, especially in Belleville ships, though in the case of the Spartiate endless trouble was some while ago experienced in the engine-room before she could get through her trials. Her boilers, it should, however, be noted, never gave any trouble. She was reported in the daily press as having been re-tubed, but this, we find, is incorrect. It was the condensers that were "doctored"—to use the phrase that Sir William Allan has recently made classic in another direction.

The Europa is—or was—the ship at which Sir William Allan used to launch his special thunderbolts. According to Sir William, she was known in the navy as "H. M. S. Hell," on account of the tremendous heat below. The present Europa, however, is hardly the same ship in many ways, for her boilers were almost entirely re-tubed after that famous voyage which, more than any other, led to the doom of Bellevilles. It is certainly the irony of fate that this very vessel should now have done so much to revoke that doom! But a still more extraordinary fact is behind it. The Europa, after her refit, was examined by the boiler committee, and pronounced incapable of making the voyage to China and back. A special committee, however, gave a somewhat different verdict, and so the ship got sent. It can hardly be said, however, that many expected to see her return—except in tow. In the betting on the event—for there were innumerable bets exchanged—it was two to one against the Spartiate, it averaged ten to one against the Europa! The boiler committee appears to have washed its hands of the affair altogether—the programme having been arranged by the controller of the navy, Admiral W. H. May. The general idea was as follows:—"The two ships have been in commission for some little while. War suddenly breaks out, and before any repairs can be effected, they are in active service, cruising and chasing. Can they in those conditions steam 10,000 miles, touching harbor only to coal?" Of the excellence and wisdom of such a test there can be no question; and, the type of boiler having already been condemned as "unsuitable for the British navy," the chances of breakdowns could be cheerfully faced. The general idea was not, however, exactly followed, for, economy supervening, the ships were used as transports, and shipped fresh crews at Hong-Kong, which was manifestly a handicap to some extent. Otherwise the scheme was carried through.

The first part was accounted for by the voyage out. This the Spartiate did at an average of 13 knots, burning 2600 tons of coal. The Europa did her 10,000 miles at a mean of 10.75 knots, and burned 3600 tons. The best cylindrical record is that of the Blenheim—4000 tons, and this used to be regarded as very good.

The following are the details of the engine-room complements for the voyage out. In the Spartiate the chief engineer, Engineer-Lieutenant Gaudin, is of course, the most experienced Belleville officer in the service. His reputation to a great extent was at stake. The senior engineer was also fairly experienced in Bellevilles; three engineer sub-lieutenants had had some Belleville training; another had never seen them before. Neither had the three artificer engineers. Of the E. R. A.'s, four were experienced, half the remainder are enterd as knowing something about them, the other half were absolutely raw to water-tube boilers. Seventy-five per cent of the chief stokers were experienced men, and half the stokers slightly experienced. The other half were raw hands to stoking of any sort.

In the Europa the chief had had two years' experience in the Hyacinth, the senior engineer had done six months in the Arrogant, and the Navy List shows one A. E. with a year in the Andromeda—a successful Belleville ship. One artificer engineer, two chief stokers, and 20 per cent of the stokers were experienced. All the E. R. A.'s had little, if any Belleville training; 20 per cent of the chief stokers had some little experience. Twenty-five per cent of the stokers were the raw second-class variety. All told, therefore, she was a pretty raw ship. At Hong-Kong the Spartiate kept forty stokers, three chief stokers, and five E. R. A's. These, with six leading stokers, were permanent staff. About 80 per cent of the new men came from the Ocean, and so had three years' experience. The Europa took the leavings of the Ocean—thirty stokers—and drew the rest of her men from the small ships of the station, including men from the Rosario. She got no experienced petty officers at all, and again had an indifferent lot of ratings in the matter of training.

The ships left at once for home. Both did the same programme, except that the Spartiate had to abandon one trial on account of a hot bearing in the crank head. Speed was continually changed. The special runs included three 8-hour full power runs, a 54-hour 3/5 power—which averaged 18 knots—a 32-hour at the same, and a 4/5 from Gibraltar to Devonport, against a head wind, force 6—7. In this the Spartiate logged 18 knots and the Europa 17.6. Each had about .5 knot better "engine speed"—the weather cut them down.

The average coal consumption in the Europa was 1.91, which is close to the fancy trial records. Though the cruise was mostly in the tropics, no single stoker fainted on 20,000 miles in either ship. Six deck hands fainted in the Europa's bunkers, but soon came round. None fainted in the Spartiate.

At high speeds about a hundred deck hands went below to the bunkers. The Spartiate consumed 6 tons of water per 1000 indicated horsepower per 24 hours—the Europa about 5½ tons. Both ships easily made all the water that they required—a point of far more importance than the figure the consumption stands at. In the Europa one condenser leaked for a little while. The Spartiate had the hot bearing already mentioned, and one or two leaky joints, but she is without a single defect of consequence. The Europa had no trouble with either engines or boilers, and has no defects at all.

The total coal consumptions for all purposes during the 10,000 mile return journey were:—Spartiate, 4500 tons; Europa, 5600 tons.

It will be noted that the Spartiate's consumption is the better of the two, both on the easy voyage out and the hard one home. This, however, is in keeping with the first trials, on which the Spartiate was 25 per cent better than the Europa. On this trip her superiority was 19 per cent only, so that the Europa did somewhat better with her own crew than in the contractors' trials, which few ever looked to see repeated.—*Engineer.*

DROWNED COAL.—The run of the Spartiate to China and back emphasizes the importance of the experiments which the Admiralty are carrying out on the preservation of steam coal by submersion, says the *Naval*

and Military Record. On the run out the ship burned 3000 tons of coal, and on the home run 4400, an increase, in round numbers, of 50 per cent. The bulk of the coal consumed one way had been stacked in England; the whole of the coal consumed on the run home had been stacked on tropical or semi-tropical stations. And in exact ratio to the bad quality of the coal and the heat of the climate, so was the work of the stokers increased. It may be assumed that the coal shipped on the foreign stations was of fairly good quality of its kind, for it not infrequently happens that the increased consumption goes up 100 per cent. If, however, the submersion trials prove what they are hoped to prove, coal shipped at Aden or Hong-Kong will have the same endurance as fuel shipped at Devonport or Portsmouth.—*Iron Age.*

BOOK NOTICES.

The Cadets' Hand Book, a manual for military students at colleges and academies, by Captain John A. Lockwood, U. S. Army (retired), contains a great deal of useful information for young men of military schools, and especially for those who intend to enter the regular army from civil life. The character of the work is shown by the table of contents, as follows:

Chapter I. Military Colleges.
" II. Discipline. Duties of Cadet Officers.
" III. The U. S. Army. Composition and Organization.
" IV. Staff and Administrative Departments, U. S. Army.
" V. The National Guard. Duties of Officers, etc.
" VI. Orders and Correspondence.
" VII. Flags, Honors, Civil Authority, Rosters.
" VIII. Courts Martial.
" IX. Elements of Military Engineering.
" X. Military Hygiene.
" XI. First Aid to the Wounded.
" XII. Camping. How to Pitch and Strike Tents.
" XIII. Marches.
" XIV. Lines and Bases of Operations.
" XV. U. S. Military Academy, West Point. Method of Appointment, Examination, etc.
" XVI. How Commissions are Obtained in the U. S. Army. Appendix. Articles of War.

Published by the Hudson-Kimberly Publishing Co., Kansas City, Mo.

The INSTITUTE is in receipt of "The Fighting Fleets of 1903," by Commandant de Balincourt, just published by Berger-Levrault and Co., 5 rue des Beaux-Arts, Paris.

The present edition of this well-known publication differs from its predecessors in describing the French war fleet as well as those of other nations. Containing complete and accurate descriptions of all the war fleets of the various naval powers, in alphabetical order, with a brief account of the organization and relative value of each navy, and fully illustrated, this work will be of great value to those who desire to keep abreast of the times in naval affairs. Price 6 francs.

The INSTITUTE is also in receipt of a copy of a "Handbook for Non-commissioned Officers of Infantry," by Captain M. B. Stewart, 8th U. S. Infantry. This handbook is one of the latest military publications of the Hudson-Kimberly Publishing Company, of Kansas City, Mo., and must prove a valuable help to those for whom it is intended—non-commissioned infantry officers. As applied to the army, it is along the same lines as the recent handbooks for petty officers and recruits in the naval service, and naval petty officers will find this handbook useful to them in many ways, especially in such duties ashore as outpost duty, escorts, patrols, and as 1st petty officers and guides of companies. It is a neatly bound book of 102 pages, convenient to carry and would be useful to naval officers as well as petty officers for quick reference when required to land battalions or companies at short notice and establish outposts and patrols. Its chapters on advance and rear-guard duty, escorts, patrols and outposts are clearly illustrated, thus adding to a quick comprehension of details. Price 50 cents.

LIST OF PRIZE ESSAYS.

1879.

Naval Education. Prize Essay, 1879. By Lieut.-Com. A. D. Brown, U.S.N.

NAVAL EDUCATION. First Honorable Mention. By Lieut.-Com. C. F. Goodrich, U.S.N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U.S.N.

1880.

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U.S.N.

1881.

The Type of (I) Armored Vessel, (II) Cruiser best suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U.S.N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U.S.N.

1882.

Our Merchant Marine: The Causes of its Decline and the Means to be taken for its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. J. Kelley, U.S.N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U.S.N.

"SPERO MELIORA." Honorable Mention. By Lieut.-Com. F. F. Chadwick, U.S.N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U.S.N.

1883.

How may the Sphere of Usefulness of Naval Officers be extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U.S.N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U.S.N.

"CUILIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U.S.N.

1884.

The Reconstruction and Increase of the Navy. Prize Essay, 1884. By Ensign W. I. Chambers, U.S.N.

1885.

Inducements for Retaining Trained Seamen in the Navy, and Best System of Rewards for Long and Faithful Service. Prize Essay, 1885. By Commander N. H. Farquhar, U.S.N.

1886.

What Changes in Organization and Drill are Necessary to Sail and Fight Effectively Our Warships of Latest Type? "Scire quod nescias." Prize Essay, 1886. By Lieutenant Carlos G. Calkins, U.S.N.

THE RESULT OF ALL NAVAL ADMINISTRATION AND EFFORT FINDS ITS EXPRESSION IN GOOD ORGANIZATION AND THOROUGH DRILL ON BOARD OF SUITABLE SHIPS. Honorable Mention. By Ensign W. L. Rodgers, U.S.N.

1887.

The Naval Brigade: its Organization, Equipment and Tactics. "In hoc signo vinces." Prize Essay, 1887. By Lieutenant C. T. Hutchins, U.S.N.

1888.

Torpedoes. Prize Essay, 1888. By Lieut.-Com. W. W. Reisinger, U.S.N.

1891.

The Enlistment, Training and Organization of Crews for our Ships of War. Prize Essay, 1891. By Ensign A. P. Niblack, U.S.N.

DISPOSITION AND EMPLOYMENT OF THE FLEET: SHIP AND SQUADRON DRILL. Honorable Mention, 1891. By Lieutenant R. C. Smith, U.S.N.

1892.

Torpedo-boats: their Organization and Conduct. Prize Essay, 1892. By Wm. Laird Clowes.

1894.

The U.S.S. Vesuvius, with Special Reference to her Pneumatic Battery. Prize Essay, 1894. By Lieut.-Com. Seaton Schroeder, U.S.N.

NAVAL REFORM. Honorable Mention, 1894. By Passed Assistant Engineer F. M. Bennett, U.S.N.

1895.

Tactical Problems in Naval Warfare. Prize Essay, 1895. By Lieut.-Com. Richard Wainwright, U.S.N.

A Summary of the Situation and Outlook in Europe. An Introduction to the Study of Coming War. Honorable Mention, 1895. By Richmond Pearson Hobson, Assistant Naval Constructor, U.S.N.

Suggestion for Increasing the Efficiency of Our New Ships. Honorable Mention, 1895. By Naval Constructor Wm. J. Baxter, U.S.N.

The Battle of the Yalu. Honorable Mention, 1895. By Ensign Frank Marble, U.S.N.

1890.

The Tactics of Ships in the Line of Battle. Prize Essay, 1896. By Lieutenant A. P. Niblack, U.S.N.

The Organization, Training and Discipline of the Navy Personnel as viewed from the Ship. Honorable Mention, 1896. By Lieutenant Wm. F. Fullam, U.S.N.

Naval Apprentices, Inducements, Enlisting and Training. The Seaman Branch of the Navy. Honorable Mention, 1896. By Ensign Ryland D. Tisdale, U.S.N.

The Composition of the Fleet. Honorable Mention, 1896. By Lieutenant John M. Ellicott, U.S.N.

1897.

Torpedo-boat Policy. Prize Essay, 1897. By Lieutenant R. C. Smith, U.S.N.

A Proposed Uniform Course of Instruction for the Naval Militia. Honorable Mention, 1897. By H. G. Dohrman, Associate Member, U.S.N.I.

Torpedoes in Exercise and Battle. Honorable Mention, 1897. By Lieutenant J. M. Ellicott, U.S.N.

1898.

Esprit de Corps: A Tract for the Times. Prize Essay, 1898. By Captain Caspar Frederick Goodrich, U.S.N.

Our Naval Power. Honorable Mention, 1898. By Lieut.-Com. Richard Wainwright, U.S.N.

Target Practice and the Training of Gun Captains. Honorable Mention, 1898. By Ensign R. H. Jackson, U.S.N.

1900.

Torpedo Craft: Types and Employment. Prize Essay, 1900. By Lieutenant R. H. Jackson, U.S.N.

The Automobile Torpedo and its Uses. Honorable Mention, 1900. By Lieutenant L. H. Chandler, U.S.N.

1901.

Naval Administration and Organization. Prize Essay, 1901. By Lieutenant John Hood, U.S.N.

1903.

Gunnery in Our Navy. The Causes of its Inferiority and Their Remedies. Prize Essay, 1903. By Professor Philip R. Alger, U.S.N.

A Naval Training Policy and System. Honorable Mention, 1903. By Lieutenant James H. Reid, U.S.N.

Systematic Training of the Enlisted Personnel of the Navy. Honorable Mention, 1903. By Lieutenant C. L. Hussey, U.S.N.

Our Torpedo-Boat Flotilla. The Training Needed to Insure its Efficiency. Honorable Mention, 1903. By Lieutenant E. L. Beach, U.S.N.

NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its twenty-eighth year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

Sec. 5. Associate members shall be elected from officers of the Army Revenue Marine, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: " Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing.

The Proceedings are published quarterly, and may be obtained by non-members upon application to the Secretary and Treasurer at Annapolis, Md. Inventors of articles connected with the naval profession will be afforded an opportunity of exhibiting and explaining their inventions. A description of such inventions as may be deemed by the Board of Control of use to the service will be published in the Proceedings.

Single copies of the Proceedings, $1.00. Back numbers and complete sets can be obtained by applying to the Secretary and Treasurer, Annapolis, Md.

Annual subscriptions for non-members, $3.50. Annual dues for members and associate members, $3.00. Life membership fee, $30.00.

All letters should be addressed to Secretary and Treasurer, U. S. Naval Institute, Annapolis, Md., and all checks, drafts and money orders should be made payable to his order, without using the name of that officer.

OFFICERS OF THE INSTITUTE.

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SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1904.

A prize of two hundred dollars, with a gold medal, and a life-membership in the Institute, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1904. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. If, in the opinion of the Board of Control, the best essay presented is not of sufficient merit to be awarded the prize it may receive "Honorable Mention" or such other distinction as the Board may decide.

5. In case one or more essays receive "Honorable Mention," the writer of the first of them in order of merit will receive seventy-five dollars and a life-membership in the Institute.

6. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

7. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

8. All essays submitted must be either type-written or copied in a clear and legible hand.

9. In the event of the Prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

By direction of the Board of Control.

PHILIP R. ALGER,
Professor, U. S. N., Secretary and Treasurer.